



सत्यमेव जयते

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Report of the
Comptroller and Auditor General of India
on

Management of Launch Services



Union Government
Department of Space
Report No. 33 of 2016
(Performance Audit)

16 DEC 2016

Presented to Lok Sabha on.....

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Table of Contents

	Description	Page Number
	Preface	iii
	Executive Summary	v
Chapter 1	Introduction	
1.1	Background	1
1.2	Polar Satellite Launch Vehicle	1
1.3	Geosynchronous Satellite Launch Vehicle	3
1.4	Organisation set up	3
1.5	Expenditure on launch vehicle technology	4
1.6	Why we selected this topic	5
1.7	Audit Objectives	6
1.8	Audit Scope and Methodology	6
1.9	Audit Criteria	7
1.10	Arrangement of audit findings	7
1.11	Acknowledgement	7
Chapter 2	Realisation of PSLV launch services	
2.1	Process of realisation of PSLV	9
Part A	Planning for PSLV launches	
2.2	Background	10
2.3	Absence of policy on planning and delivery of PSLV launch services	12
2.4	Under realisation of vehicles	12
2.5	Time and cost escalation of national missions	13
Part B	Price recovery for PSLV launch services	
2.6	Absence of policy on pricing of PSLV launch services	17
2.7	Unilateral fixing of prices for commercial missions by Antrix	18
2.8	Revenue remittances by Antrix to Department of Space	19
2.9	Non-uniform service charges recovered by Antrix	20
2.10	Pricing methodology of PSLV launch service	20
2.11	Short realisation of price in commercial main missions	23
2.12	Short realisation of price in commercial co-passenger missions	25
2.13	Non-realisation of price in Non-Government missions	26
2.14	Conclusion	27
2.15	Recommendations	28

Chapter 3 Delivery of PSLV launch services		
3.1	Introduction	29
3.2	Prescribed procedure not followed for entering into launch service agreements	29
3.3	Selection of co-passengers for PSLV launch services	30
3.4	Non-adoption of best practices in PSLV launch service agreements	31
3.5	Conclusion	34
3.6	Recommendations	34
Chapter 4 Launch of Geo-stationary satellites		
4.1	Background	35
Part A	Planning for the launch of Geo-stationary satellites	
4.2	Synchronisation issues in GSLV MK II operational launch vehicle	36
Part B	Procurement and contract management issues in the procured launch for Geo-stationary satellites	
4.3	Irregular award of work to contractor other than L1	38
4.4	Loss in INSAT 3D contract	39
4.5	Loss on competitive bid due to obligation of postponement fee of INSAT 3A	41
4.6	Loss due to non-incorporation of Liquidated Damages clauses in Procured Launch Service Contracts	41
4.7	Loss of interest due to non-incorporation of time schedule for the refund of mass variation credit	42
4.8	Conclusion	43
4.9	Recommendations	43
Annexures		45-48
Glossary of Terms		49

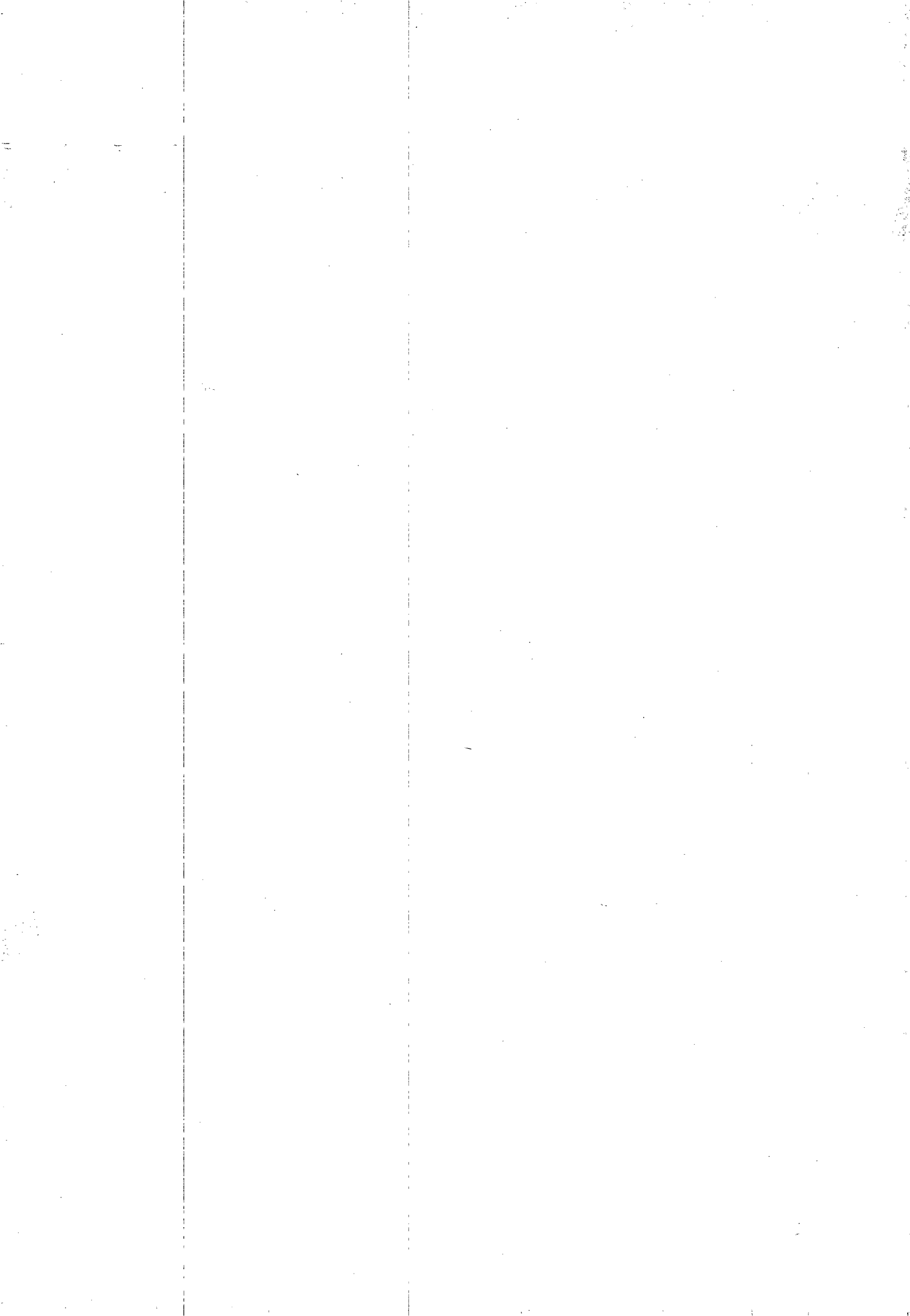
Preface

One of the major programmes of the Department of Space (DOS) is the design and development of launch vehicles for carrying satellites into space. The Department has two operational launch vehicles viz. Polar Satellite Launch Vehicle (PSLV) and Geosynchronous Satellite Launch Vehicle (GSLV). Indian PSLV launch services are the most reliable and sought after launch services in the world. The Department has operationalised indigenous GSLV which is capable of launching 2,000 kg class of satellite. However, DOS is yet to operationalise indigenous GSLV capable of launching 3,000 kg plus class of geo-stationary satellites. To launch such satellites, DOS procures launch services from other space agencies.

This Report of the Comptroller and Auditor General of India contains significant results arising from performance audit of Management of Launch Services. The audit findings arose out of test check of PSLV contracts entered between January 2007 and March 2016 and procured launch service contracts entered from September 1998 to March 2016.

This report has been prepared for submission to the President under Article 151 of the Constitution for being laid before the Parliament.

Audit has been conducted in conformity with the Auditing Standards issued by the Comptroller and Auditor General of India.



Executive Summary

Introduction

Department of Space (DOS) is responsible for implementation of space programmes through its various establishments. One of the programmes of DOS is the design and development of launch vehicles which are used to carry satellites to space. In the implementation of this objective, DOS provides launch services to meet national requirements and commercial needs. DOS has two operational launch vehicles viz. Polar Satellite Launch Vehicle (PSLV) and Geosynchronous Satellite Launch Vehicle (GSLV).

PSLV launches satellites which are meant for remote sensing, navigational and communication applications. It is in its operational phase and utilises the resources and facilities created from Government funds. There have been 34 PSLV launches from 1993 to 2016 (as of March 2016). Of these, three were developmental missions and the remaining 31 were operational missions. DOS started offering PSLV launch services to co-passenger missions from May 1999 but more frequently from January 2007 onwards and to commercial main missions from April 2007 onwards. PSLV launch services are offered to private users in main missions as well as co-passenger missions.

GSLV is used to launch Geo-stationary satellites meant for communication related applications into Geo-stationary orbit above equator at around 36,000 km altitude. There have been nine GSLV launches from 2001 to 2015. Of these, six missions were successful and three were unsuccessful. Out of the six successful launches, four were of developmental nature and remaining two were used for operational purpose. The present capability of DOS is to launch 2,000 kg class of communication satellite to Geo-stationary Transfer Orbit (GTO) using a GSLV. DOS is yet to operationalise indigenous GSLV capable of launching 3,000 kg plus class of satellites. Therefore, DOS resorted to procured launches for its communication satellites by hiring launch vehicle services from other space agencies.

Main findings

Significant audit findings on realisation, delivery of PSLV launch services and launch of Geo-stationary satellites are as follows:

Realisation of PSLV launch services

The assessment of demand of PSLV among various categories of users, basis for assigning the priority to various sectors, guidelines and procedures were not on record. DOS did not put in place a policy for planning and delivery of PSLV launch services.

(Para 2.3)

Against 33 launches planned during the period 2007-16, DOS accomplished 24 missions thereby falling short by nine missions which resulted in under utilisation of resources.

(Para 2.4)

Non-synchronisation of the satellite development programme with that of launch vehicle development programme resulted in delays in planned and approved missions. DOS deviated from approved national missions and launched six commercial missions in place of Union Cabinet approved national missions.

(Para 2.5.1, 2.5.2)

DOS did not formulate a policy for pricing of PSLV launch services duly approved by Ministry of Finance, as in the case of other space products such as leasing of satellite transponder capacity and sale of remote sensing data products. In the absence of the same, prices of commercial PSLV missions were fixed unilaterally by Antrix without following approval process.

(Para 2.6, 2.7)

Of the total revenue of ₹ 791.01 crore realised by Antrix from PSLV launch services, only ₹ 145.76 crore (18 *per cent*) was transferred to Government account; revenue of ₹ 445.23 crore realised from four commercial missions was credited to PSLV deposit project head and ₹ 141.88 crore (18 *per cent*) was retained by Antrix instead of crediting the same to Government Account.

(Para 2.8)

No policy was framed for fixing service charges payable to Antrix for delivery of PSLV services. Against the six dedicated commercial missions launched by DOS, Antrix received ₹ 707.97 crore and retained service charges of ₹ 129.17 crore which varied from eight *per cent* to 28 *per cent*.

(Para 2.9)

In the six commercial main mission contracts, there was short realisation of selling price to DOS to the extent of ₹ 363.57 crore. DOS was not able to recover even the cost of launch services in these contracts. Similarly, DOS was not able to realise the selling price in any of the 19 co-passengers launched, resulting in short realisation of ₹ 41.31 crore. Cost of launch services was also not recovered in 16 co-passenger launches.

(Para 2.11, 2.12)

DOS did not frame a policy on pricing for PSLV launch services and its guidelines for the amount to be charged from private educational institutions, Universities and other Non-Government users. DOS provided PSLV launch services to private Universities/ Institutions free of cost, which resulted in non-realisation of revenue from these users to the extent of ₹ 17.95 crore.

(Para 2.13)

Delivery of PSLV launch services

There was no approved mechanism for submission, examination (from administrative and financial angles) and approval of proposals for delivery of PSLV launch services in DOS. Documentation relating to due process to be followed in the finalisation of PSLV launch service agreements were not on record. Contracts entered into by Antrix were not vetted from financial angle by DOS/ Space Commission/ Ministry of Finance.

(Para 3.2)

There was no documented policy on the procedure for selection of co-passenger customers by Antrix and the manner of delivery of PSLV services to such customers duly approved by the competent authority particularly when there was huge demand for PSLV launch services and co-passenger satellites. For the national/ commercial main missions, optimum pay load capacity was not utilised in five missions. The unutilised capacity ranged between 11 kg to 65 kg, which is substantial given that the current per kg cost of the Core Alone version of PSLV was ₹ 18.70 lakh per kg.

(Para 3.3)

Best practices such as mass variation clause, advance payment, etc. that DOS committed to in the procured launch service contracts entered into with external agencies were not included in the PSLV launch service agreements for services offered by DOS. This resulted in loss of ₹ 2.55 crore to DOS in 10 co-passenger contracts due to non-inclusion of the mass variation clause.

(Para 3.4)

Launch of Geo-stationary satellites

DOS got its operational communication satellites approved when GSLV MK II with indigenous cryogenic engine did not complete its developmental missions. Due to non-synchronisation of communication satellite development programme with the GSLV launch vehicle development programme, three communication satellites developed at the cost of ₹ 611.90 crore were idling/ delayed for periods ranging from six to seven years.

(Para 4.2)

DOS/Indian Space Research Organisation (ISRO) inserted a new condition for the evaluation of bids for procured launch services for the satellites INSAT 4A and INSAT 4B which made Ariane Space France the lowest bidder. ISRO did not follow the basic principles of public procurement enshrined in General Financial Rules and extended undue favour to Ariane Space France.

(Para 4.3)

DOS did not finalise a contract for launch of INSAT 3D within the validity period of the tender which led to cancellation of the procurement process and re-tendering. The contract was subsequently awarded to the same vendor at a price that was higher by ₹ 97.06 crore.

(Para 4.4)

DOS delayed in launch of INSAT 3A and thereby incurred liability for payment of postponement fee to the launch service provider for the delayed launch. DOS awarded the next contract for launch of INSAT 4A/4B to the same launch service provider to avail of waiver of postponement fee offered by the vendor and had to forego the lowest bid submitted by another vendor.

(Para 4.5)

DOS did not incorporate clause for Liquidated Damages in any of the procured launch contracts. This resulted in loss of ₹ 85.33 crore in two contracts for launch of INSAT 3C and GSAT 15.

(Para 4.6)

Conclusion

DOS did not formulate a policy for planning, delivery and pricing of PSLV launch services. The absence of approved policy affected the planning and delivery of PSLV services. DOS could not synchronise the satellite development programme with that of launch vehicle development programme. Consequently, there were deviations from approved launch schedule and launch of unapproved commercial missions.

There was no prescribed procedure and approval mechanism for preparation and revision of PSLV launch plan, documentation requirements and pricing of operational PSLV missions. Fixing of prices for commercial launches was unilaterally done by Antrix and there was no uniformity in service charges recovered by Antrix for commercial missions. The revenue realised by Antrix from launch services was not entirely credited to Government account. Further, service charges were also retained by Antrix instead of depositing the same in Government account.

DOS was unable to realise the selling price of PSLV from its main and co-passenger missions and did not realise charges for PSLV services offered to private educational institutions, Universities and other Non-Government users.

There was no approved mechanism for examination and vetting of proposals for delivery of PSLV launch services from administrative and financial angles. There was also no documented and approved policy for selection of co-passenger customers and realisation of payments for PSLV launch services. Contractual provisions such as mass variation clause, advance payment, etc. that DOS committed to in the procured launch services were not included in the PSLV launch service agreements for services offered by DOS.

Due to non-synchronisation of planning of communication satellite development programme with GSLV launch vehicle development programme, three communication satellites were idling/ delayed for a long period of six to seven years.

There were instances of poor contract management such as award of contract to launcher other than L1, cancellation of contracts without giving valid reasons, uncertain terms for refund of negative mass variation credit, etc.

Summary of recommendations

1. DOS may evolve a mechanism for synchronisation of satellite and launch vehicle development programmes to ensure timely launch of missions.
2. DOS may frame a policy on planning, delivery and pricing of PSLV launch services and lay down clear guidelines on preparation and revision of PSLV launch plan, documentation requirements, approval mechanism, pricing of operational PSLV missions and service charges to Antrix.
3. DOS may fix prices of the PSLV services in individual contracts on the basis of the pricing methodology formulated and after benchmarking with international prices of similar services and with the approval of competent authority.
4. DOS may follow the Government approved principle of 'user pays', in the delivery of PSLV launch services to educational institutions, Universities and

other Non-Government users. For any relaxation, the approval of competent authority may be obtained.

5. DOS may ensure that proposals for PSLV launches are examined and approved by the Space Commission and Ministry of Finance.
6. DOS may establish a mechanism for submission, examination and vetting of proposals for PSLV customers and put in place a policy for selection process for PSLV customers.
7. DOS may ensure that contractual provisions commonly followed internationally are also duly incorporated in the contracts entered for PSLV launch services.
8. DOS may document a policy for fixing of terms of payment in PSLV contracts.
9. DOS may adhere to rules/guidelines in GFR/ CVC Guidelines/DOS purchase procedure and streamline the processes in the award of launch service contracts.

1

CHAPTER





1.1 Background

The Government of India (GoI) constituted the Space Commission and established the Department of Space (DOS) in June 1972. Space Commission formulates policies and oversees implementation of the Indian space programme to promote the development and application of space science and technology for the socio-economic benefit of the country. DOS is responsible for implementation of space programmes through its various establishments. The Indian Space Research Organisation (ISRO) is the research and development (technical) wing of DOS which coordinates implementation of the programmes and schemes of DOS. Design and development of launch vehicles is carried out by Vikram Sarabhai Space Centre, Thiruvananthapuram (VSSC), a unit of DOS, as the lead centre.

One of the programmes of DOS is the design and development of launch vehicles which are used to carry satellites to space. DOS is committed to carrying out research and development in launch vehicle technology with a goal to achieve total self-reliance. In the implementation of this objective, DOS provides launch services primarily to meet national requirements and spare capacity available is used to meet commercial requirements. DOS also launched six exclusive commercial missions as of December 2015.

DOS has two operational launch vehicles viz. Polar Satellite Launch Vehicle (PSLV) and Geosynchronous Satellite Launch Vehicle (GSLV).

1.2 Polar Satellite Launch Vehicle

PSLV launches satellites¹ which are meant for remote sensing, navigational and communication applications. It is in its operational² phase and utilises the resources and facilities created from Government funds.

¹ Polar Satellites are satellites launched into a polar orbit and sub-Geo-stationary Transfer Orbit.

² Initially, launch vehicle missions are realised in developmental mode. In its developmental missions, DOS validates its technologies and proven vehicles are declared operational which would be used for operational purposes intended for benefit (social/economic) from the missions.

PSLV is a four stage launch vehicle. The purpose of the PSLV is to launch satellites to various orbits. The first (PS1) and third stage (PS3) use solid rocket motors and the second (PS2) and fourth (PS4) stage use liquid motors. PSLV has three versions viz. (i) Generic Version (PSLV G)³ (ii) Core Alone Version (PSLV CA)⁴ and (iii) XL Version (PSLV XL)⁵. PSLV G and PSLV XL are similar versions. While, PSLV G has standard 11.3 metre, six solid strap-on motors at PS1; XL version has six larger strap-on motors measuring 12 metre. PSLV CA is a core alone version without strap-on motors.

The fourth stage of the PSLV vehicle, PS4, carries a main mission (principal satellite) and co-passenger satellites. The main mission satellite weighs more than 300 kg. The balance payload capacity available in the launch vehicle after determining the main mission is used to launch co-passenger satellites, which are nano⁶ and micro⁷ satellites.

There have been 34 PSLV launches from 1993 to March 2016. Of these, three were developmental missions and the remaining 31 were operational missions. Except the first PSLV launch, all the subsequent 33 PSLV missions were successful. DOS started offering PSLV launch services to co-passenger missions from May 1999⁸ but more frequently⁹ from January 2007 onwards and to commercial main missions from April 2007 onwards. PSLV launch services are offered to private users in main missions as well as co-passenger missions.

Launch Vehicle Programme Office (LVPO) of ISRO is associated with the PSLV launch services and coordinates the launch vehicle activities at ISRO Head Quarters and Antrix Corporation Limited (Antrix). Antrix is a Central Public Sector Undertaking under administrative control of DOS, established (under Companies Act, 1956) in September 1992 for marketing the products and services of DOS/ISRO. It is the commercial arm of DOS and enters into agreement with the private/ commercial users. As of March 2016, Antrix had entered into 34 contracts for the delivery of PSLV launch services.

³ The generic version of PSLV (PSLV G) is capable of launching satellite weighing 1,500 kg to Sun Synchronous Polar Orbit achieved at the altitude of 600 km in which a satellite crosses over the equator at approximately the same local time each day and night.

⁴ The core alone version of PSLV (PSLV CA) can launch satellite weighing up to 1,000 kg to Sun Synchronous Polar Orbit.

⁵ PSLV XL is capable of launching satellite weighing 1,700 kg to Sun Synchronous Polar Orbit and 1,425 kg to Sub Geo-stationary Transfer Orbit (with a perigee-low point around 284 km and an apogee-high point of about 20,650 km).

⁶ A nano satellite is a small satellite weighing from five to 25 kg.

⁷ A micro satellite weighs up to 150 kg.

⁸ Between May 1999 and January 2007, PSLV launch service was provided to only four co-passenger missions.

⁹ Between January 2007 to March 2016, there were 45 co-passenger missions.

1.3 Geosynchronous Satellite Launch Vehicle

GSLV is used to launch Geo-stationary satellites¹⁰ meant for communication related applications into circular Geo-stationary orbit above equator at around 36,000 km altitude. There have been nine GSLV launches from 2001 to 2015. Of these, six missions were successful and three were unsuccessful. Out of the six successful launches, four were of developmental nature and remaining two were used for operational purpose.

The present capability of DOS is to launch 2,000 kg class of communication satellite to Geo-stationary Transfer Orbit¹¹ (GTO) using a GSLV. DOS is yet to operationalise indigenous GSLV capable of launching 3,000 kg plus class of satellites. Therefore, DOS resorted to procured launches for such communication satellites by hiring launch vehicle services from other space agencies.

In order to realise communication satellites through procured launches, DOS enters into Procured Launch Service Agreements (PLSAs) with the launch service providers. The units of DOS associated with procurement of launch services for communication satellites are ISRO Satellite Centre, Bengaluru (ISAC) which indents and procures launch services for communication satellites and Satellite Communication and Navigational Programme Office (SCNPO) of ISRO which coordinates communication satellite related activities.

From the year 2000 to 2016, 18 operational Geo-stationary satellites were launched. Of these, six satellites were launched using indigenous GSLV launch vehicles (GSLV MK II) while 12 satellites were launched using procured launch services. As of March 2016, DOS had entered into five PLSAs for launch of these 12 communication satellites.

1.4 Organisation set up

DOS is headed by a Secretary who reports to the Prime Minister of India. The Secretary of DOS is also the ex-officio Chairman of Space Commission and Chairman of ISRO. The Space Commission is a ten-member committee consisting of senior level officers of GoI and distinguished scientists.

The units¹² of ISRO are headed by Directors who report to Secretary of DOS. Antrix is headed by a Chairman cum Managing Director. The Antrix Board, which comprises

¹⁰ A Geo-stationary satellite is a satellite with an orbital period the same as the earth's rotation period and thus, would appear at a fixed spot above earth.

¹¹ Geosynchronous Transfer Orbit (GTO) of 35,861 km apogee (farthest point to earth) and 258 km perigee (closest point to earth).

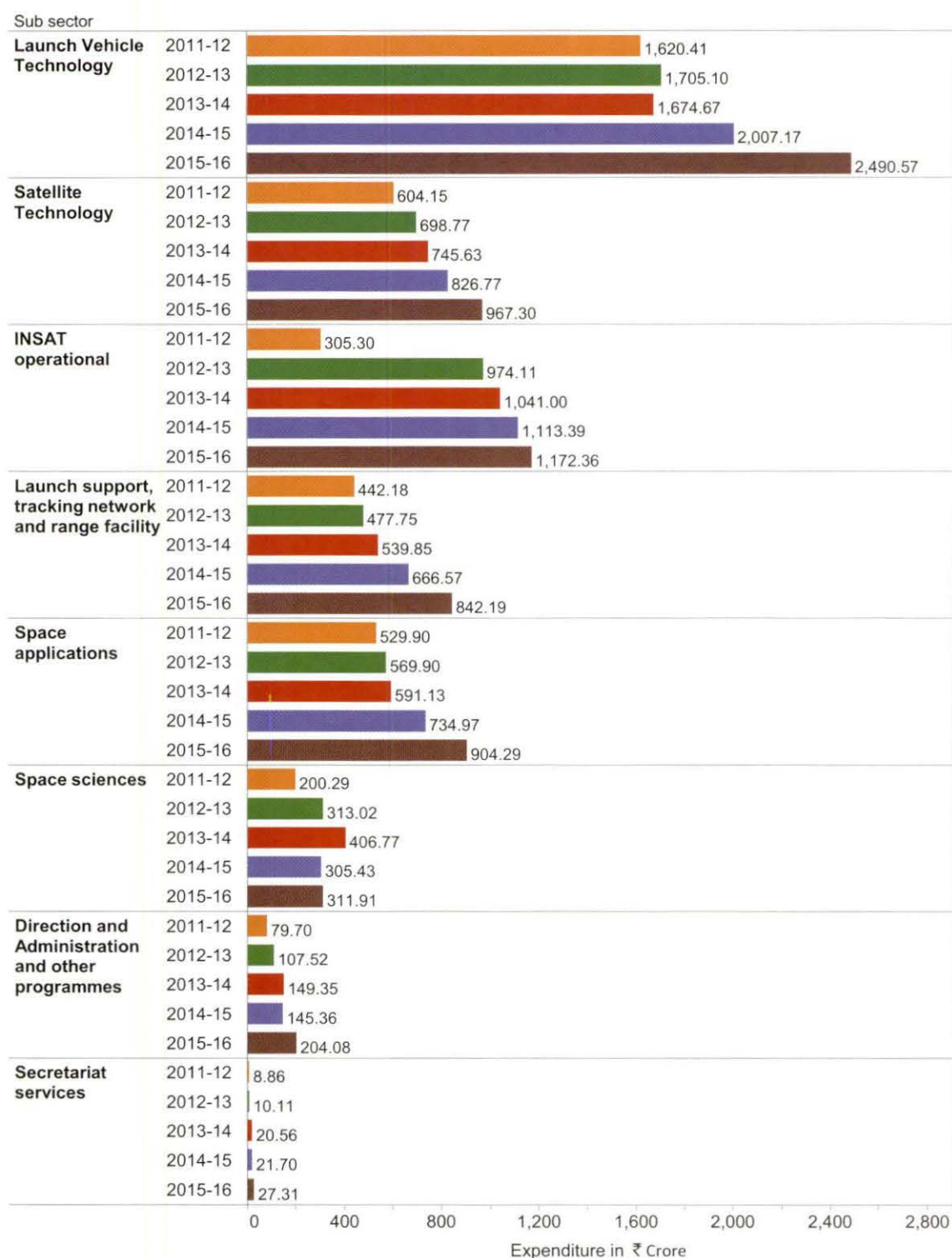
¹² **VSSC:** Vikram Sarabhai Space Centre, Thiruvananthapuram; **LPSC:** Liquid Propulsion Space Centre; **SDSC/SHAR:** Satish Dhawan Space Centre, Sriharikota; **ISAC:** ISRO Satellite Centre, Bengaluru; **SAC:** Space Applications Centre, Ahmedabad; **NRSC:** National Remote Sensing Centre, Hyderabad.

of 12 Directors including nominees from Gol and ISRO, provides the overall policy and guidance.

1.5 Expenditure on launch vehicle technology

During the financial years 2011-16, the total expenditure incurred by DOS was ₹ 26,557.40 crore. Of this, DOS incurred expenditure of ₹ 9,497.92 crore (36 *per cent*) on launch vehicle technology for development of PSLV and GSLV and ₹ 3,842.62 crore on satellite technology (14 *per cent*). Chart 1.1 shows the details of expenditure incurred by DOS from 2011-12 to 2015-16.

Chart 1.1: Sector-wise expenditure of DOS



1.6 Why we selected this topic

We took up the performance audit of the Management of Launch Services by DOS taking into consideration factors such as (a) substantial budgetary outgo on development of launch vehicle technologies, (b) high expenditure on PSLV for delivery of commercial launch services vis-a-vis extent of revenue realisation from

such services and (c) substantial expenditure on costs of procured launch services for launch of communication satellites.

1.7 Audit Objectives

The objectives of the Performance Audit were to evaluate whether:

- a. Planning and related processes for realisation of PSLV launch services were streamlined and price recovery from launch services was adequate and competitive;
- b. Management of delivery of PSLV launch services ensured optimum utilisation of available capacities; and
- c. Planning and realisation of launch of Geo-stationary satellites was economic, efficient and effective.

1.8 Audit Scope and Methodology

The performance audit of Management of Launch Services included audit of PSLV launch services, launch of Geo-stationary satellites through indigenous operational GSLV missions and procured launch services for launch of communication satellites. The scope of audit encompasses the following:

- a. The period covered for audit of PSLV launch services was from January 2007 (period of commencement of commercial launch services) to March 2016. Out of 34¹³ contracts, 27¹⁴ contracts were covered in audit. Of the 27 contracts reviewed in audit, 25 were commercial contracts and two contracts were for collaborative missions;
- b. Two operational indigenous GSLV missions (GSLV F01 and GSLV F04) that launched two Geo-stationary satellites; and
- c. Procured launch contracts for communication satellites. As there were only five contracts entered between September 1998 and October 2013, all these contracts were reviewed to have a fair and balanced view.

Audit was conducted by scrutiny of records at DOS and Antrix. An entry conference was held on 17 June 2015 in which audit objectives, scope and methodology were explained to DOS. Exit meeting was held on 20 July 2016 in which the audit findings and recommendations along with reply of DOS were discussed. Deliberations in the exit meeting have been incorporated in the report under the relevant paras and shared with DOS. Further comments of DOS (November 2016) have also been incorporated under the relevant paras.

¹³ 31 operational PSLV missions (excluding three developmental missions) and 92 satellite launches.

¹⁴ 24 PSLV missions and 66 satellite launches (28 main missions and 38 co-passengers).

1.9 Audit Criteria

The audit criteria were derived from the followings:

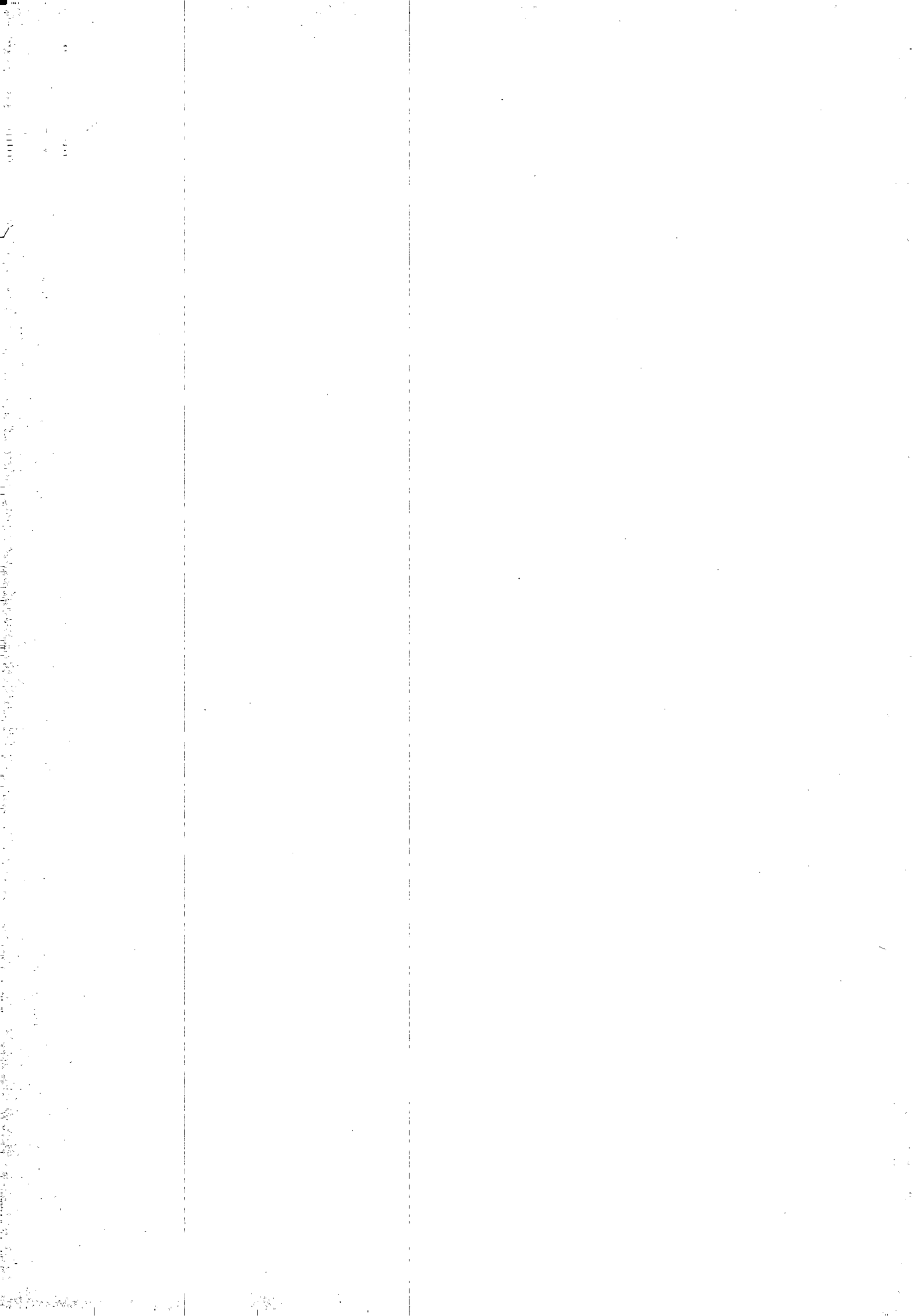
- a. Launch Manifest indicating launch dates of each mission for the 11th (2007-12) and 12th (2012-17) plan periods;
- b. Financial sanctions of PSLV launch vehicles and procured launches of communication satellites;
- c. Minutes of meetings of various committees formed for management of launch services;
- d. Financial provisions regarding demand, collection and remittance of non-tax revenues to Government Account;
- e. Instructions/ Circulars/ Orders/ Office Memorandum issued by DOS;
- f. Memoranda of Understanding between DOS and Antrix;
- g. International best practices in the delivery of PSLV launch services and pricing and launch services of communication satellites;
- h. Procured launch service contracts entered by DOS; and
- i. DOS book of financial powers.

1.10 Arrangement of audit findings

Chapter 2 deals with planning, realisation and pricing of PSLV. Chapter 3 deals with management of delivery of PSLV service. Issues relating to planning and realisation for launch of Geo-stationary satellites are discussed in Chapter 4.

1.11 Acknowledgement

We wish to acknowledge the cooperation extended by Department of Space (DOS), Indian Space Research Organisation (ISRO), Vikram Sarabhai Space Centre (VSSC) and Antrix during the conduct of audit.





2

CHAPTER



2

Realisation of PSLV launch services

Chapter

2.1 Process of realisation of PSLV

The process of realisation of PSLV involves three stages viz. (i) Planning of the launch vehicle and satellite; (ii) Obtaining approvals for launch vehicle and satellite; and (iii) Development of the launch vehicle and its satellite, followed by the launch.

DOS prepares a five-year launch manifest for each Five-Year plan period identifying the launch vehicle together with its main satellite missions. Considering the availability of resources and requirements given in the launch manifest, financial sanction to launch firm PSLV missions for the ensuing four to five year period is obtained from the Union Cabinet. After obtaining the financial sanction, launch vehicles are developed and realised. The lead time required for launch of a PSLV is generally two years, involving material procurement and fabrication of vehicle by DOS/ ISRO units and its external work centres in about 18 months followed by stacking, fixing the payload/ satellite, testing and launch of the vehicle which takes about six months.

Union Cabinet accorded approval for 43¹⁵ PSLV missions (as of June 2015) for various satellite missions. Against the sanctioned budget of ₹ 5,953.52 crore, DOS incurred expenditure of ₹ 3,207.97 crore as of March 2016 on 31 operational missions. The expenditure incurred vis-a-vis sanctioned amount are detailed in Table 2.1.

Table 2.1: Expenditure incurred by DOS against sanctioned budget under PSLV missions

PSLV missions	Launch period	Sanction date	Sanctioned amount (₹ crore)	Expenditure ¹⁶ (₹ crore)
C1 to C3	1996 to 1999	16 Nov 1994	255.59	255.59
C4 to C6	2002 to 2004	31 Oct 1997	410.34	410.34
C7 to C13	2004 to 2008	30 June 2003	679.59	679.59
C14 to C28	2009 to 2013	26 Mar 2008	1,518.00	1,518.00
C36 to C50	2016 to 2020	5 June 2015	3,090.00	344.45
Total			5,953.52	3,207.97

¹⁵ Excluding seven missions that were sanctioned for other purposes (e.g. Chandrayaan and Mars Orbiter Mission)

¹⁶ The expenditure on PSLV operational missions excludes expenditure on Research and Development.

This chapter brings out audit observations on the following:

Part A: Planning for PSLV launches

Part B: Price recovery from PSLV launch services

Part A- Planning for PSLV launches

2.2 Background

DOS launched 34 PSLV missions including three developmental and 31 operational PSLV missions during the period from 1993 up to March 2016. The 31 operational vehicles launched 92 satellites for national missions for Government and Non-Government users and international commercial private parties, consisting of 37 main mission satellites and 55 co-passenger satellites.

The details of operational PSLV launches planned, sanctioned and realised is shown in Table 2.2.

Table 2.2: PSLV operational missions planned, sanctioned and launched

Plan Period/Year	PSLV missions planned	Satellites planned	PSLV missions sanctioned	PSLV missions launched	Satellites launched	Co-passenger satellites launched
Prior to 2002	3	3	3	3	3	4
X/2002-07	9	10	11	4	5 ¹⁷	3
XI/2007-2012	19	23	15	10	11 ¹⁸	24
XII/2012-2017 (up to March 2016)	14	14	5	14	18 ¹⁹	24
Total	45	50	34^{20*}	31^{20#}	37	55

Yearwise planning in five year launch manifest, financial sanction and actual launch of satellites and launch vehicles used is detailed in **Annexure 1**.

A Coordination Management Committee of DOS and Antrix (CMC-DOSIA), constituted by DOS in 2011, decides the commercial PSLV launch vehicle projects that are to be built into the launch manifest of DOS/ISRO. The determination of cost of the launch, entering into contracts with commercial users and responsibility for the launch services rests with Antrix. As of March 2016, Antrix had entered into 34 contracts for the delivery of PSLV services of DOS. Out of 31 operational PSLV missions, 92 satellites and 34 contracts, we reviewed 24 PSLV missions, 66 satellites

¹⁷ PSLV C7 carried two main national missions- Cartosat 2 and SRE-1 satellites.

¹⁸ PSLV C9 carried two main national missions- Cartosat 2A and IMS-1 satellites.

¹⁹ PSLV C21 carried one commercial mission SPOT 6 and an additional national mission Mini Resins; and PSLV C23 carried one commercial mission SPOT 7 and an additional national mission AINS satellite; and PSLV C28 carried three commercial main missions viz. DMC 3.

^{20*} 43 PSLV missions were sanctioned up to June 2015 for the launches up to March 2020. Of these, 34 PSLV missions were sanctioned for the period up to March 2016.

[#] These exclude three developmental missions of PSLV.

(28 main missions and 38 co-passengers) and 27 contracts entered during the period from January 2007 to July 2015. Of the 27 contracts of Antrix reviewed in audit, 25 were commercial contracts and two contracts were for collaborative missions.

The satellites launched for national and Government users, Non-Government users and private users along with details of commercial contracts entered with the private users are detailed in Table 2.3.

Table 2.3: Category of users of PSLV operational missions

Users	Beneficiary	PSLV Missions	Satellites	Contracts	PSLV/Satellites / contracts reviewed by Audit	Weight in kg
Government/ National users	ISRO/ NRSC ²¹ for remote sensing, communicati on and basic science; GSAT-12 and two science missions	17	21	0	10/12/0	20,090.00
	AAI ²² /ISRO for Navigation	6	6	0	6/6/0	8,564.30
	ISRO-CNES ²³	2	2	2	2/2/2	1,407.00
Subtotal:		25	29	2	18/20/2	
Non- Government users	SRM University, Anna University, Amateur Radio Operators, IIT Kharagpur, Youthsat, Studsat	Launched as co- passengers to the above national main missions	6	0	0/4/0	193.00
Private Commercial users	Main Mission	6	8	6	6/8/6	
	Co-Passenger Mission	Launched as co- passengers to the above national and commerca l main missions	49	26	0/34/19	5,294.60
Total		31	92	34	24/66/27	35,548.90

²¹ National Remote Sensing Centre, a unit of DOS.

²² Airports Authority of India.

²³ French Space Agency.

The table shows that more than 80 per cent of the PSLV missions of ISRO were launched to meet Government requirements and the remaining for Non-Government and private users. The year wise PSLV launches made are detailed in Annexure 2.

2.3 Absence of policy on planning and delivery of PSLV launch services

DOS/ ISRO/ VSSC/ PSLV project office identify the users for each PSLV mission in the five year launch manifest and also in Union Cabinet approved project reports. We observed that assessment of demand of PSLV among various categories of users, basis for assigning the priority to various sectors, guidelines and procedures were not on record. DOS did not put in place a policy for planning and delivery of PSLV launch services. Consequently, there was no prescribed procedure and approval mechanism for preparation and revision, if any, of the launch manifest, documentation requirements, obtaining approval/sanction for the missions identified in the launch manifest as well as approvals to subsequent deviations, if any. Responsibility and accountability levels for the stages involved in preparation, revision and approval of launch manifest were also not laid down. Therefore, we could not draw assurance on the following in absence of policy:

- a. Assessment of the need in various sectors such as remote sensing, science and commercial use;
- b. Assigning of priority for various categories of users such as Government/ Non-Government and Private sectors;
- c. Planning for the identified and prioritised missions in the five-year launch manifest; and
- d. Procedure for drawing up firm annual launch plan and its execution.

We found cases which resulted in under realisation of vehicles, deviations in approved missions, non-synchronisation of launch vehicle with satellite, etc. which are discussed in the succeeding paragraphs.

DOS stated (July 2016) that planning was done as a part of five year planning and inter-se priorities in the missions are discussed and finalised in the ISRO Council meeting held every year. DOS added that the national priorities, development status and readiness schedule of the satellites, mission requirements/compatibility, launch infrastructure and international commitments are major considerations while arriving at the launch manifest. However, DOS agreed (July 2016) to document the procedure being followed for planning and delivery of PSLV missions along with the approval mechanism and authority for approval and revisions, etc. as a policy.

2.4 Under realisation of vehicles

Based on the resources (human, technology, facility, finance) at DOS and industry/work centre participation, DOS, with the approval of Union Cabinet, planned four

PSLV launches in a year during the 11th plan period and beyond (2007-16). Against 33 launches planned during this nine year period (2007-16), DOS could accomplish only 24 missions, thereby falling short by nine missions, which resulted in under utilisation of resources.

DOS stated (July 2016) that PSLV launches approved in 11th and 12th Plan periods were 15 and 14 respectively. DOS further stated (July 2016) that delay in the development of satellites had delayed launch vehicle missions. DOS also stated that money appropriated in the Budget Estimates was not made available to the Department due to cuts made by the Ministry of Finance (MoF) during the Revised Estimate stage.

We sought (August 2016) the details of these approved planned missions; however, DOS provided details of 14 approved plan missions for the 12th plan period only. According to the records provided to us during the course of audit, 19 launch vehicles and satellites were identified in the mission profile of 11th plan period.

Reply of DOS on the availability of funds is not acceptable since DOS had surrendered ₹11,531.89 crore during the nine-year period 2007-16. Revised Estimates are prepared by the Department during the middle of the financial year after carrying out thorough study of schemes/ projects/ activities to avoid large scale un-spent provision under each unit of appropriation. We found no instances in which budget proposals for projects were subjected to mandatory cuts by MoF. The position stated by DOS is also contrary to the explanations given in the Appropriation Accounts that savings under various units of appropriations were due to reasons such as non-approvals/ delayed approvals of projects, requirement of less funds, postponement of activities, etc.

2.5 Time and cost escalation of national missions

Out of 92 satellites launched by 31 PSLVs from September 1997 to March 2016, 29 satellites were for national missions i.e. satellites launched for Government and national users, of which we reviewed 20 cases. We observed that there were time lags between development of launch vehicles and satellites in 18 out of 20 missions. Consequently, while the launch vehicles were ready, the corresponding satellites identified for the PSLV were not developed in time to align with the planned launch schedule. This led to delays in planned launches, resulting in time overrun ranging between 13 months to about eight years. This also resulted in cost escalation of the 18 delayed missions by ₹535.98 crore. Further, we noticed instances of deviations from approved national missions for launch of commercial missions in six cases.

Some interesting issues relating to non-synchronisation of launch vehicle development programme with satellite development programme are discussed below.

2.5.1 Non-synchronisation of launch vehicle with satellite

The launch vehicle development programme and satellite development programme follow separate realisation cycles. DOS obtains the financial sanction for PSLV missions and satellite missions separately. Bulk financial sanctions (up to 15 PSLV missions) for five years are generally obtained for PSLV. These financial sanctions identify/ indicate satellites for each mission. The lead time for realisation of PSLV is two years from the date of approval of the PSLV mission. The financial sanction for individual satellites are taken separately. The time required for realisation of the satellite is three years from the date of approval of the satellite mission.

Thus, though satellites to be launched are identified in Government approved PSLV missions, approval for each satellite mission is obtained separately. The launch vehicle development programme and satellite development programme were, therefore, to be developed in a synchronised manner to avoid idling of launch vehicle/delay in launch of satellite and cost escalation of the vehicle/ satellite missions. We observed gaps in planning for launch vehicle development programme with satellite development programme as mentioned below.

- a. The Government approved Astrosat satellite project in August 2004. The launch vehicle approved for the mission was PSLV C10 and the launch was identified in 2005-06. The satellite was inordinately delayed by more than eight years and was launched in September 2015, which led to cost escalation of ₹ 59.54 crore.

DOS stated (July 2016) that the project was delayed due to realisation of complex designs, longer lead time for availability of components and developmental uncertainties. However, we observed that there was no written MoU/ contract with the agencies associated with the project for laying down terms and conditions for timely delivery of the mission consumables of the respective agencies, which led to delay in realisation of the satellite.

- b. Aditya satellite was approved in December 2009 and was to be realised within 32 months time by August 2012. Aditya was approved as a mission with PSLV C27 in 2012-13. However, the satellite was not realised as of March 2016. The cost escalation was to the tune of ₹ 29.73 crore.

DOS stated (July 2016) that Aditya Mission was redefined and rescheduled to make its scientific objectives in tune with the global developments. The fact remained that the satellite was inordinately delayed by 43 months as of March 2016, which led to cost escalation.

- c. Resourcesat-3, Hyperspectral and Cartosat-3 were three important national remote sensing missions approved by the Government in 2008 and planned for launch during 2011-13 using PSLV C22, PSLV C26 and PSLV C28 launch

vehicles respectively. Though the PSLV missions were approved in 2008, Resourcesat-3, Hypersectral and Cartosat-3 were sanctioned in August 2012, August 2013 and May 2015 respectively. However, the satellites were not realised as of March 2016. The cost escalation of the missions was to the extent of ₹ 103.52 crore.

DOS stated (July 2016) that formulating the projects for Cartosat-3 and Resourcesat-3 took more time due to technical complexities. The fact remained that delay in obtaining approval for the satellites led to delay in their realisation and consequent cost escalation.

Thus, non-synchronisation of the satellite development programme with that of launch vehicle development programme resulted in delays in planned and approved missions.

DOS stated (July 2016) that synchronous development of satellite and corresponding launch vehicles are never attempted at the approval stages, since the technologies and development cycles for satellites and launch vehicles are entirely different. DOS added that launch vehicles are highly standardised and are realised in a production mode unlike satellites which are unique by themselves.

As Union Cabinet approved the satellite missions while approving PSLV launches, synchronisation of satellite and launch vehicle development programmes was to be ensured to avoid idling of vehicles. This was also evident from the Prime Minister's Office (PMO) instructions (August 2014) to DOS to commit actual capacity utilisation for each PSLV launch, prior to placing 15 PSLV launches (C36-C50) before Union Cabinet.

2.5.2 Deviations from approved missions

Satellites identified against each PSLV mission were required to be launched as per the launch vehicle schedule approved by the Union Cabinet. These missions approved by the Cabinet clearly indicated the satellites to be launched with each PSLV mission. We noticed that none of these approvals included commercial missions. The Union Cabinet had approved only three commercial main missions for the years 2018-19 and 2019-20.

Our scrutiny revealed that during the period from April 2007 to March 2016, DOS deviated from approved national missions to launch commercial missions as detailed in Table 2.4.

Table 2.4: Deviations from approved national missions

National missions approved	Approved year of launch	Commercial missions launched	Actual launch of national mission (Time overrun in years)	Remarks
RISAT-1	2005-06	Agile in April 2007	April 2012 (6 years)	Two commercial PSLV launch missions took priority over the planned national missions
Oceansat-2	2006-07	Polaris in January 2008	September 2009 (2 years)	
Navigational satellites	IRNSS-1A in 2009-10 to IRNSS-7 in 2011-12	SPOT 6 in September 2012 SPOT 7 in June 2014 DMC-3 in July 2015 TELEOS in December 2015	7 satellites as of April 2016 (3-4 years)	Four unapproved ²⁴ commercial missions were given priority to these national assignments

Table 2.4 shows that DOS launched six commercial missions in place of Union Cabinet approved national/social missions. The cost escalation for these six missions was ₹ 194.91 crore. As development of PSLV is carried out using GoI resources (in terms of technology, facility, manpower and finance), diversion of these resources for six commercial missions without requisite approval of Union Cabinet was irregular.

DOS stated (July 2016 and November 2016) that commercial PSLV launch missions were taken up as there was a delay in the planned national satellite missions. DOS further stated that the satellite missions mentioned in the Cabinet note were indicative only and identification of specific satellite mission for each PSLV takes place during the annual ISRO Council meeting taking into account the readiness schedule of the satellites and national priorities. However, DOS agreed that revisions from the approved mission would henceforth be put up to the Space Commission and specific approval would be obtained.

Reply of DOS confirms our observation that non-synchronisation of the satellite development programme with launch vehicle development programme resulted in diversion of planned national missions for commercial missions. We also noticed during the course of audit that the Prime Minister's Office (PMO) had issued (August 2014) instructions to DOS to commit actual satellite capacity utilisation for each PSLV launch, prior to placing 15 PSLV launches (C36-C50) before Union Cabinet for approval. This indicates that satellite missions mentioned in the Cabinet note were

²⁴ SPOT 6 launched before IRNSS 1A, SPOT 7 launched before IRNSS 1C, DMC-3 launched prior to IRNSS 1E and TELEOS launched against IRNSS 1F.

not to be indicative. Further, as PSLV missions were approved by the Cabinet, any deviations such as change from national to commercial missions required Cabinet approval.

Part B- Price recovery for PSLV launch services

2.6 Absence of policy on pricing of PSLV launch services

PSLV launch services are one of the major space products (leasing of transponders and sale of remote sensing data products are the other entities)/services delivered by DOS to Government, Non-Government and private users. The prices of leasing of transponders and sale of remote sensing data products are fixed by a high power pricing committee of DOS for different categories for products and users and approved by MoF. We, however, noticed that DOS did not formulate a policy for pricing of PSLV launch services. In the absence of any approved pricing policy, out of six commercial missions, in only two cases prior approval of Space Commission was obtained.

The high power CMC-DOSIA constituted (July 2011) to approve the commercial projects to be undertaken through Antrix, directed DOS in its first meeting (June 2012) to provide guidelines to the concerned ISRO centres on costing and revenue remittances in PSLV launch services, which was not done. The Space Commission in its meeting of December 2013 also discussed issues relating to the general guidelines to be followed while taking up commercial launches in future. It suggested to develop standard terms and conditions for formalising the launches, ensure mention of any specific conditions and the manner in which financial and commercial arrangements were to be entered. It also deliberated that such a standard format could be approved in the Space Commission.

Our scrutiny however, revealed that the standard/ documented procedure and the manner in which the financial and commercial arrangements were to be entered were not drawn. In absence of policy/ guideline on the pricing of PSLV launch services, we could not derive assurance on the pricing methodology adopted by DOS for PSLV launch services including:

- a. Pricing methodology for ascertaining the selling price from the elements of costing such as direct material, direct labour, other direct expenses, overheads and profit of margin.
- b. Cost of Launch Services²⁵ and Selling Price for different versions of PSLV such as PSLV CA and PSLV G/XL.

²⁵ The Cost of Launch Services is the Cost of Production plus administrative and facility overheads, launch campaign charges and Telemetry, Tracking and Command Network charges.

- c. Pricing for main missions and co-passenger small satellite (Nano/ Micro Satellite) missions.
- d. Pricing applicable for dedicated commercial missions and margin available for negotiation with the customers considering the international prices.

DOS stated (July 2016) that PSLV development was a strategic initiative primarily intended for meeting launch requirements of national missions and full-fledged commercial launches started only from September 2014. DOS further stated that Launch Service Agreements for co-passengers and dedicated satellite launches had all standard terms and conditions including the financial and payment plan which were being followed for all commercial satellite launches.

Since DOS provides launch services to Government, Non-Government and Private users, a pricing policy for formalising such launches needs to be established with the approval of MoF, as is being done in the case of other space products of DOS such as leasing of satellite transponder capacity and sale of remote sensing data products.

The absence of pricing policy also led to instances of unilateral fixing of prices of ISRO's commercial missions by Antrix, payment of substantial service charges to Antrix for such launches and under realisation of prices from various missions, which are discussed in the succeeding paragraphs.

2.7 Unilateral fixing of prices for commercial missions by Antrix

As mentioned in para 2.2, CMC-DOSIA decides the commercial PSLV launch vehicle projects of DOS/ISRO. The Committee was to ensure co-ordination between DOS/ISRO and Antrix. The Committee in its first meeting (June 2012) directed that DOS would provide guidelines to the concerned ISRO centres on PSLV launch services. However, this was not done. In the absence of such guidelines, Antrix unilaterally fixed the prices of commercial PSLV missions.

The issue of unilateral commitment of the space products and services by Antrix to its customers without following the approval process in DOS was also reported in CAG's Audit Report No. 4 of 2012-13²⁶. Antrix stated (July 2015) that prices were fixed in consultation with PSLV project office and with the approval of the Space Commission. DOS/ PSLV project office stated (October 2015) that unit cost available in the approved project reports was made available to Antrix for fixing the price. The reply confirms that prices were being fixed by Antrix. Further, there were no documents in support of the consultation mechanism existing between PSLV project office and Antrix as stated by them. Out of six dedicated missions reviewed, the prices of only the last two missions (DMC 3 and TELEOS) were fixed with the prior approval of Space Commission (December 2013).

²⁶ Hybrid Digital Satellite Multimedia Agreement with Devas.

DOS stated (July 2016 and November 2016) that the approval of Space Commission was being obtained for launch of exclusive commercial missions and agreed to consider seeking in-principle approval for price range taking into account various categories of co-passenger satellites.

The fact remained that DOS obtained prior approval of the Space Commission in respect of only two out of six commercial missions. Further, as prices of other space products of DOS such as leasing of transponders and sale of remote sensing data products were approved by MoF, prices of launch services also required the approval of the same.

2.8 Revenue remittances by Antrix to Department of Space

According to Rule 6 of Receipt and Payment Account Rules, 1983, all moneys received or tendered on account of revenues or receipts or dues of the Government shall, without delay be paid in full into the accredited bank for inclusion in Government account. To incur departmental expenditure, the money shall be appropriated after being duly authorised by the Parliament.

The money received by DOS from the delivery of space products and services is credited to the departmental revenue head '1425.00.102-Space Research'. The revenue realised from 25 commercial contracts examined in audit and amount transferred to DOS/ ISRO up to the period 2015-16 are detailed in the Table 2.5.

Table 2.5: Revenue from PSLV services and remittance to DOS (₹ in crore)

Description	Revenue received by Antrix	Transferred to Government account	Amount transferred to deposit project head	Total transfer by Antrix	Service Tax paid by Antrix	Amount retained by Antrix
Commercial Main Mission Contracts	707.97	79.32	445.23	524.55	54.25	129.17
Commercial Co-passenger Contracts	83.04	66.44	0.00	66.44	3.89	12.71
Total	791.01	145.76	445.23	590.99	58.14	141.88

Table 2.5 shows that of the total revenue of ₹ 791.01 crore realised by Antrix, amount to the extent of only ₹ 145.76 crore (18 per cent) was transferred to Government Account. We further noticed that revenue of ₹ 445.23 crore realised from four commercial missions viz. SPOT 6, SPOT 7, DMC 3 and TELEOS was credited to PSLV deposit project head '8443.00.117' instead of the departmental revenue head. The Table 2.5 also shows that Antrix retained revenue of ₹ 141.88 crore, which was 18 per cent of the total revenue realised from PSLV commercial launches. This was irregular, as revenues realised from the PSLV launch services rendered from Government budget were to be credited to Government Account and were not to be transferred to deposit project head or retained by Antrix as service charges. Any

amount to be utilised for projects or paid to Antrix as service charges was to be appropriated under Parliamentary authorisation.

DOS stated (July 2016) that the Department will examine this issue separately taking into account the views of Audit.

2.9 Non-uniform service charges recovered by Antrix

In the case of delivery of communication satellite capacity (transponders), DOS fixed (March 2008) service charges of 15 to 20 *per cent* of revenue realised as payable to Antrix. However, no similar policy was formulated for delivery of PSLV launch services. In absence of same, Antrix recovered service charges ranging between eight *per cent* to 28 *per cent* for delivery of PSLV services. Against the six dedicated commercial missions launched by DOS, Antrix received ₹ 707.97 crore and retained service charges of ₹ 129.17 crore which varied from eight *per cent* to 28 *per cent*. Similarly, against 19 co-passenger missions, Antrix received ₹ 83.04 crore and retained service charges of ₹ 12.71 crore which varied from eight *per cent* to 20 *per cent*.

We also noticed that service charges were not fixed after taking into account various aspects such as the objective of Antrix as an organisation providing service linkages to DOS without any trading or manufacturing activities of its own, location of company within DOS premises, minimum number of manpower²⁷ etc.

DOS stated (July 2016) that the efforts put in by Antrix were not uniform for all satellite missions but varied based on mission requirements, technological complexities and other factors which could not be quantified. However, DOS agreed to document the service charges after obtaining approval of competent authority.

2.10 Pricing methodology of PSLV launch service

The PSLV project office at VSSC worked out unit costs of PSLV from the expenditure they incur towards launch vehicle consumables and fabrication charges and estimated the unit cost of the vehicle during the years 2002-03, 2007-08 and 2013-14. The escalated unit cost for the in-between years (2003-04 to 2006-07, 2008-09 to 2015-16) were worked out from the incremental escalation.

However, the unit cost worked out by PSLV project office did not include expenditure incurred on salaries of the officials working for the development of PSLV, administrative overheads, expenditure incurred on travel, office expenses and works overheads and expenditure incurred on repairs and maintenance of the facilities used for PSLV (facility overheads), expenditure towards launch campaign

²⁷ The total number of staff working in Antrix was 18 (as of September 2015), of which 14 were ISRO officials working in Antrix on 'working arrangement basis'.

incurred by Satish Dhawan Space Centre, Sriharikota (SHAR), tracking expenditure incurred by the ISRO Telemetry, Tracking and Command Network, Bengaluru (ISTRAC) to track the launch vehicle during the launch and finally the capital cost of the huge facility at various DOS/ ISRO centres. Thus, the unit cost adopted by DOS was not in alignment with accepted principles of costing.

DOS agreed (July 2016) to revisit the pricing methodology.

In the absence of an approved pricing methodology, we worked out the prices of PSLV based on information available in the five units of DOS/ISRO involved in PSLV realisation, viz. VSSC, Liquid Propulsion Systems Centre, Bengaluru (LPSC), SHAR, ISRO Propulsion Complex, Mahendragiri (IPRC) and ISRO Inertial Systems Unit, Thiruvananthapuram (IISU) as shown in Table 2.6.

Table 2.6: Costing of PSLV launches

Cost element	Source of data	Costing methodology adopted by DOS	Costing methodology adopted by Audit
Unit Cost	Government of India approved project reports of PSLV during the years 2003, 2008 ²⁸ and 2013 ²⁹	Unit cost was estimated by DOS in its Union Cabinet approved project reports of PSLV during the years 2003, 2008 and 2013. The escalated cost for the in-between years from 2003-04 to 2006-07 and 2008-09 to 2012-13 were worked out from the incremental escalation in these years. The escalation in unit cost from 2003-04 to 2007-08 was taken as 2.42 per cent and from 2008-09 onwards, it was 5.4 per cent.	Unit cost of PSLV was adopted from the estimate prepared by DOS
Salary Overhead	E-lekha and Appropriation Accounts	Not worked out by DOS	Hanumantha Rao Committee ³⁰ of VSSC identified (2000) 74,000 mandays of staff required for the realisation of one PSLV. This would be equivalent to 154 employees working for two years at the rate of

²⁸ The figures in the project report prepared by DOS in 2007 (2007-08) were approved by Union Cabinet in March 2008.

²⁹ The figures in the project report prepared by DOS in 2013 (2013-14) were approved by Union Cabinet in June 2015.

³⁰ An internal committee of VSSC which carried out an internal study and suggested a professional pricing mechanism based on various inputs.

Cost element	Source of data	Costing methodology adopted by DOS	Costing methodology adopted by Audit
			20 working days in month over a period of two years for realisation of PSLV. The salary of 154 employees was arrived at from the total salary of around 8,000 staff working in ISRO units for the years 2002-03 to 2014-15.
Administrative Overheads	E-lekha and Appropriation Accounts	Not worked out by DOS	Actual expenditure incurred on Overtime Allowance, Domestic and Foreign Travel, Office Expenses and Other Administrative expenses of the ISRO units proportionately worked out for 154 personnel for two years.
Facility Overheads	Practice followed in the PSLV project office. Figures in e-lekha and Appropriation Accounts	Not worked out by DOS	The facility maintenance cost being fixed charge, the cost per vehicle is arrived by dividing this facility maintenance cost with number of PSLV launches in a year to arrive at the facility overhead per vehicle in a given year.
Launch Campaign charges	Government of India approved project reports of PSLV	Not worked out by DOS	Launch Campaign charges were estimated by DOS in approved project reports of PSLV during the years 2003, 2008 and 2013. The escalation in unit cost from 2003-04 to 2007-08 was 4.30 per cent and from 2008-09 onwards, the escalation was 9.80 per cent.
Telemetry Tracking and Command Network (TTC) charges	Conservative basis	Not worked out by DOS	A conservative cost of one per cent of unit cost was considered for the TTC support provided by ISTRAC to PSLV launch.

The Cost of Launch Services (COL) of one PSLV was worked out from the sum of the above cost elements. The Selling Price (SP) per vehicle to DOS was worked out from the sum of COL, DOS margin of 15 per cent and Antrix margin on actual charged basis.

We applied the above pricing methodology on PSLV missions launched by DOS and compared the prices worked out with those actually recovered by Antrix. Our findings are given in the succeeding paragraphs.

DOS agreed in the exit meeting (July 2016) that overhead elements were not considered. DOS, however, stated (November 2016) that the report of the Hanumantha Rao Committee was an internal study by VSSC for the purpose of financing options of PSLV and cannot be taken as the bench mark.

As the cost of launch services was not worked out by DOS, the estimates are worked out based on various inputs such as figures in Appropriation accounts of DOS (salary and administrative overheads), Government approved project reports of PSLV (unit cost) and Hanumantha Rao Committee report (salary overheads). The estimate in respect of overheads is based on 154 employees per PSLV mission as against DOS reported requirement of 273 employees per PSLV mission, to be on a conservative side.

2.11 Short realisation of price in commercial main missions

PSLV launched six commercial main missions (as of March 2016), viz. Agile, Tecsar, SPOT 6, SPOT 7, DMC 3 and TELEOS using five Core Alone versions (CA8, CA10, CA21, CA23 and CA29) and one XL version C28 of PSLV. Antrix realised an amount of ₹ 707.97 crore in these six commercial contracts and transferred ₹ 524.55 crore to DOS.

Applying the costing methodology described in para 2.10, we calculated the COL of the PSLV main missions by considering various cost elements and worked out SP by adding DOS margin of 15 *per cent* and Antrix margin and after reducing the co-passenger revenue from each. We compared the SP thus worked out with the actual amount received by Antrix for the PSLV missions. We observed that there was short realisation of SP to the extent of ₹ 363.57 crore in all the six contracts, which resulted in loss to DOS by ₹ 363.57 crore. The mission wise details are shown in Table 2.7.

Table 2.7: Details of delivery of PSLV main mission (₹ in crore)

Main Mission/ Contract Date/ Date of Launch	Short realisation
AGILE/ CA8/ 13 January 2004/23 April 2007	79.32
TECSAR/ CA10/14 August 2005/21 January 2008	68.31
SPOT 6/ CA21/ 25 January 2012/ 9 September 2012	78.80
SPOT 7/ CA23/17 June 2013/ 30 June 2014	60.03
DMC-3/ C28/29 January 2014/ 10 July 2015	41.74
TELEOS/C29/ 5 February 2014/ 16 December 2015	35.37
Total	363.57

DOS could not even recover the COL in these contracts.

The contract specific issues are discussed as under:

- a. **Agile contract:** Antrix entered (January 2004) into an agreement with Cosmos International, a foreign private user, to launch its satellite using PSLV. The core alone version of PSLV CA8 launched the mission in April 2007. Due to the low inclination of the mission from the equator, co-passenger satellites were not available to fill the balance pay load capacity of the PSLV. Therefore, the entire cost of the mission was to be borne by the customer. The total payload carrying capacity of the vehicle was 740 kg and weight of the Agile satellite was 350 kg. Since balance pay load capacity was available, DOS flight tested its Advanced Avionics Module (AAM) weighing 175 kg (to test advanced launch vehicle avionics systems like mission computers, navigation and telemetry systems) and used a dual launch adapter weighing 215 kg. However, Antrix charged the client only for the payload used, thereby depriving Government of revenue due from the dedicated mission.
- b. **SPOT 6 Contract :** Antrix entered (September 2008) into a Long Term Agreement (LTA) with Austrium, France in which the company committed two PSLV missions (for launching SPOT 6 and SPOT 7 satellites) during the period 2011 to 2014. Based on the LTA, Antrix was to enter into separate launch service agreements for each mission. Prior to signature of the launch service agreement for SPOT 6 mission, the matter was referred (May 2011) to Member, Finance DOS who did not agree to the SPOT 6 launch agreement citing requirement of PSLV for augmenting national capacity and financial implications. Antrix opposed cancellation of the agreement citing damage clauses and internal ramifications in the cancellation of LTA. Antrix also highlighted that they would lose their valuable customer Austrium. Subsequently, the matter was submitted (December 2011) to the Space Commission for approval. Space Commission approved (December 2011) the proposal post facto since LTA had already been signed in September 2008 and was binding. Accordingly launch service agreement was signed (January 2012) and the core alone version of PSLV CA 21 was launched (September 2012) carrying SPOT 6. Thus, DOS agreed to unfavourable terms and conditions of the contract due to prior commitment made by Antrix without approval of Space Commission. The benefit provided by Government to the foreign private user was ₹ 58.86 crore.
- c. **SPOT 7 Contract :** Similarly, prior to signature of the launch service agreement for launch of SPOT 7, the matter was referred (April 2013) to the Space Commission for approval. The Secretary, Expenditure, Gol who is a member of the Space Commission objected to the proposal in the meeting (April 2013) and stated that considering the international launch service prices, the price should be pushed from Euro 17 to 20 million and advised

DOS to refer the LTA to Ministry of Law and Justice and record its comments. However, further action taken on the matter was not on record and DOS proceeded with the launch of the satellite. In the same meeting, the Space Commission further added that at least recovery of cost should be ensured. Accordingly, DOS negotiated with Austrium to increase the price of launch of SPOT 7 from the contracted price of Euro 14.7 million to Euro 17.1 million. The launch service agreement to launch SPOT 7 satellite was entered (June 2013) and core alone version of PSLV CA 23 launched (June 2014). The benefit provided by Government to the foreign private user was ₹ 39.45 crore.

DOS agreed (July 2016) that overhead elements were not considered and stated that the Department was in the process of costing PSLV services with the help of external consultants.

In respect of Agile contract, DOS stated that the contract was a fore runner to build the confidence of the international customers of PSLV therefore it needs to be viewed with a strategic perspective in a broader context of market building. As regards SPOT 6 and SPOT 7, DOS stated that LTA of September 2008 was essentially a marketing framework and it did not mention that the agreement was for SPOT-6 and SPOT-7.

We are of the view that commercial selling of PSLV should recover at least cost of the vehicle as observed by the Space Commission (May 2013), which was not achieved in any of the six commercial main mission contracts.

2.12 Short realisation of price in commercial co-passenger missions

Antrix entered into agreement with 19 small (Nano and Micro) satellite customers to launch their small satellites as co-passenger satellites in PSLV. Payments for co-passenger launches were, however, not received in advance. Therefore, the vehicles were realised from the Government budget. Antrix received an amount of ₹ 83.04 crore from the nine PSLV missions carrying co-passenger satellites, of which it transferred ₹ 66.44 crore to DOS.

Based on the pricing methodology as described in para 2.10, COL and SP were worked out in proportion to the weight of the co-passenger satellites. We compared the COL and SP thus worked out with the actual amount received by Antrix for these co-passenger missions. We observed that DOS did not realise the SP in any of the 19 co-passengers launched, resulting in short realisation of ₹ 41.31 crore and consequent loss to DOS. The mission wise details are given in Table 2.8.

Table 2.8: Delivery of PSLV co-passenger launches by PSLV (₹ in crore)

Satellite/Date of Launch	Main Mission	Short realisation
LAPAN TUB/C7/ 10-Jan-07	Carto-2	3.83
PEHUENSAT/C7/ 10-Jan-07	Carto-2	0.46
NLS 4/ CA9/ 28-Apr-08	Carto-2A	2.69
CAN X 6/ CA9/ 28-Apr-08	Carto-2A	1.22
RUBIN 8/ CA9/ 28-Apr-08	Carto-2A	0.67
CUBESAT/ CA14/ 23-Sep-09	Ocean-2	0.32
RUBIN 9/ CA14/ 23-Sep-09	Ocean-2	0.73
ALSAT 2A/CA15 / 12-Jul-10	Carto-2B	0.38
NLS 6/ CA 15/ 12-Jul-10	Carto-2B	1.23
X SAT/ C 16/ 20-Apr-11	Reso-2	7.82
VESELSAT/CA18/ 12-Oct-11	MEGHA	0.36
PROITERS/ CA21/ 09-Sep-12	SPOT 6	1.17
SAPHIRE/ CA20/ 25-Feb-13	SARAL	6.48
NEOSSAT/ CA20/ 25-Feb-13	SARAL	5.93
NLS 8/ CA20/ 25-Feb-13	SARAL	3.54
STRAND 1/ CA20/ 25-Feb-13	SARAL	0.67
AISAT/ CA23/ 30-Jun-14	SPOT 7	1.00
NLS 7/ CA23/ 30-Jun-14	SPOT 7	2.74
VELOX-1/ CA23/ 30-Jun-14	SPOT 7	0.07
TOTAL		41.31

We further observed that even COL was not recovered in 16 co-passenger launches.

DOS stated (July 2016) that recovery of cost happens through the main mission and the cost received through co-passenger satellites were only incidental revenue to the Government.

However, the fact remained that the COL was even not recovered in commercial co-passenger missions.

2.13 Non-realisation of price in Non-Government missions

In the case of leasing of communication satellite capacity, DOS reported (January 2002) to INSAT Coordination Committee³¹ (ICC) that MoF and Planning Commission had directed it to follow the principle of 'user pays' in the allocation of such capacity to Government users. Based on this direction, ICC decided (January 2002) to charge all users including Government departments. GoI and Space Commission also directed (2004) DOS to charge all its customers including Government users for sale of remote sensing data products. Accordingly, remote sensing satellite data products were charged from all customers including Government customers and Universities. However, as mentioned in para 2.6, DOS did not frame a Government

³¹ ICC is a high-level multi-departmental control mechanism instituted by the Government in 1977. It coordinates and monitors the implementation of space and ground segment of INSAT projects. ICC consists of Secretaries of six departments viz., DOS, Department of Economic Affairs, Department of Telecommunications, Ministry of Information and Broadcasting, Department of Science and Technology and Department of Information Technology.

approved policy on pricing for PSLV launch services and its guidelines for the amount to be charged from private educational institutions, Universities and other Non-Government users.

Out of 92 satellites launched through 31 operational PSLV missions, six satellites (co-passenger satellites) were for Non-Government users such as educational institutions, amateur radio organisations, etc. We reviewed the price recovery in four of these six satellites and found that DOS provided PSLV launch services to private Universities/ Institutions free of cost.

Similarly, based on pricing methodology described in para 2.10, COL and SP were worked out in proportion to the weight of the satellites.

Based on the calculation described above, we found that DOS did not realise SP of ₹ 17.95 crore towards the four PSLV launches carrying satellites for Non-Government users. Non-realisation of revenue from these users led to a loss of ₹ 17.95 crore to DOS.

DOS stated (July 2016) that such missions relate to satellites realised by students of Indian educational institutions and Universities, for which launch services are provided without charges using the spare launch capacity when available. DOS added that the current procedure followed for the review and clearance of Non-Government missions will be properly documented as a policy frame work by DOS.

We are of the view that such policy would be against the direction of the Government and principle of 'user pays'; however, the policy framework finalised by DOS needs to be approved by the Union Cabinet.

2.14 Conclusion

DOS did not formulate a policy for planning, delivery and pricing of PSLV launch services. Consequently, there was no prescribed procedure and approval mechanism for preparation and revision of PSLV launch plan, documentation requirements and pricing of operational PSLV missions. The absence of approved policy had an impact on both planning and delivery of PSLV services as well as recovery of cost from such launches. DOS could not synchronise the satellite development programme with that of launch vehicle development programme. Consequently, there were deviations from approved launch schedule and launch of unapproved commercial missions in place of national missions.

Fixing of prices for commercial launches was unilaterally done by Antrix and there was no uniformity in service charges recovered by Antrix for commercial missions. Service charges were retained by Antrix from the revenue realised instead of first

depositing the same in Government Account and subsequently receiving commission after due Parliamentary authorisation.

DOS was unable to realise the selling price of PSLV from its main and co-passenger missions. DOS did not realise charges for PSLV services offered to private educational institutions, Universities and other Non-Government users, even though there was a direction from MoF and Planning Commission to charge from all users in the case of other space products of DOS (communication satellite capacity and remote sensing data products).

2.15 Recommendations

We recommend that:

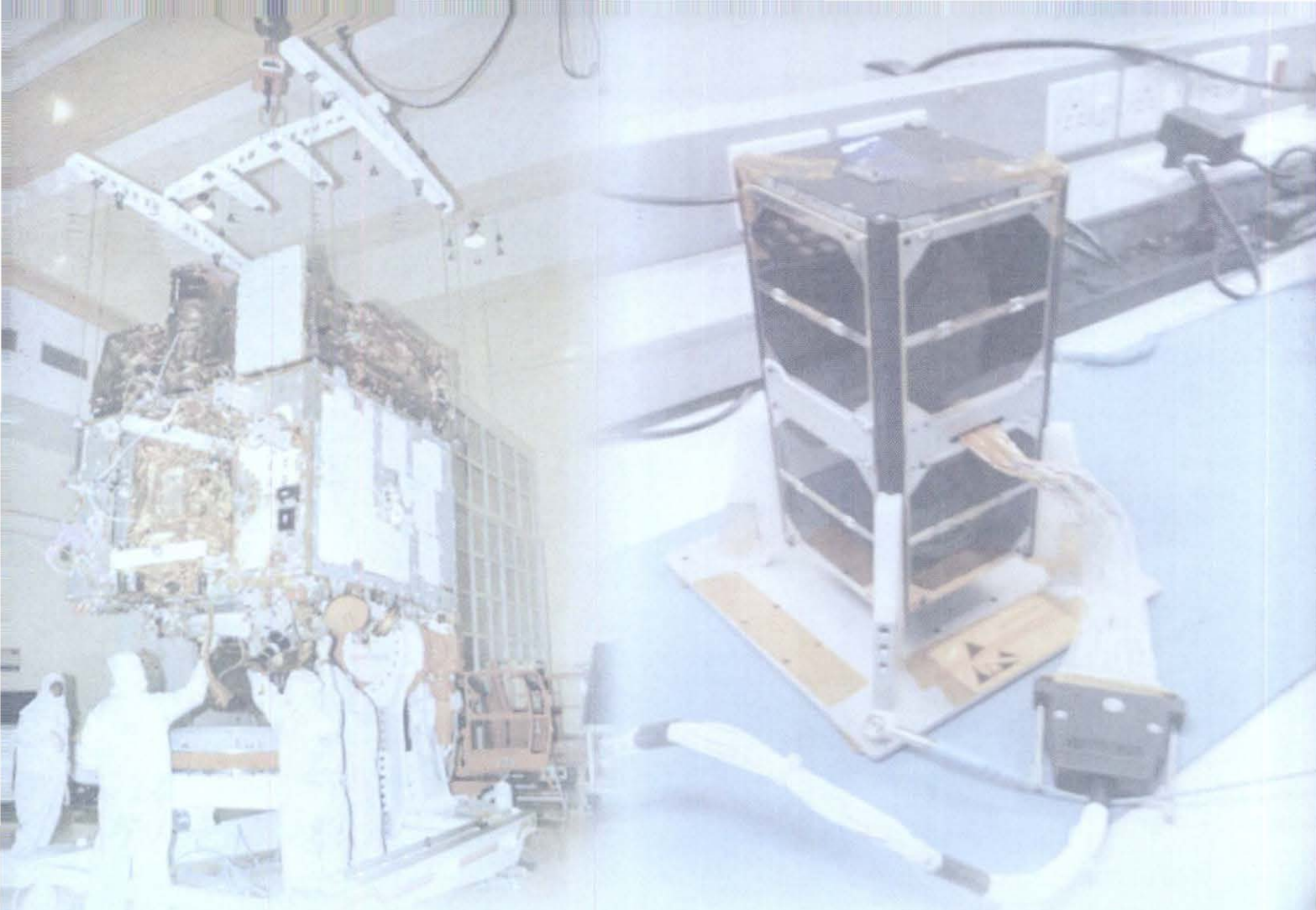
1. DOS may evolve a mechanism for synchronisation of satellite and PSLV launch vehicle development programmes to ensure timely launch of missions.
2. DOS may frame a policy on planning, delivery and pricing of PSLV launch services and lay down clear guidelines on preparation and revision of PSLV launch plan, documentation requirements, approval mechanism, pricing of operational PSLV missions and service charges to Antrix.
3. DOS may fix prices of the PSLV services in individual contracts on the basis of the pricing methodology formulated and after benchmarking with international prices of similar services with the approval of competent authority.
4. DOS may follow the Government approved principle of 'user pays', in the delivery of PSLV launch services to educational institutions, Universities and other Non-Government users. For any relaxation, the approval of competent authority may be obtained.



3

CHAPTER





3

Delivery of PSLV launch services

Chapter

3.1 Introduction

The success record of PSLV makes it one of the preferred launch vehicles in the international market and it is one of the most sought after vehicles in the Low Earth Orbit (LEO) category. The demand of PSLV missions is seen from the fact that financial sanction to PSLV C36 to C50 missions (June 2015) identified the co-passenger satellites up to 2019-20. Optimum utilisation of PSLV satellite carrying capacity and efficient management of contracts by DOS are, therefore, essential for efficient delivery of PSLV services.

This chapter details the issues in delivery of PSLV services and contract management by DOS/Antrix.

3.2 Prescribed procedure not followed for entering into launch service agreements

Rule 203 of General Financial Rules (GFR) read with Para 9 of Delegation of Financial Powers of DOS provides that contracts should be entered by the prescribed authority empowered. Rule 204 of GFR also provides for usage of approved standard forms of contracts and that modifications if any, should be carried out after obtaining financial and legal advice.

We observed that there was no approved mechanism for submission, examination (from administrative and financial angles) and approval of proposals for delivery of PSLV launch services in DOS/Antrix. Documentation relating to due process to be followed in the finalisation of PSLV launch service agreement viz. receipt of request from a customer, its processing, prices to be quoted in the bid, inclusion of terms and conditions such as mass variation clause, advance payment, launch postponement fee, etc. in international contracts and any correspondences relating to discussions and negotiations with the customer and approvals were not on record. Contracts entered into by Antrix were not vetted from financial angle by DOS/ Space Commission/ MoF (Member Finance-Space Commission), which resulted in excess payments/ losses that are discussed in Para 3.4 of this chapter.

DOS stated (July 2016) that all proposals for launch services were scrutinised by the Finance wing of Antrix.

However, as DOS is the owner of the asset created and utilised for commercial launches, proposals for PSLV launches were to be examined and approved by the Space Commission/MoF (Member Finance- Space Commission).

3.3 Selection of co-passengers for PSLV launch services

After the finalisation of the main satellite for a PSLV mission, the co-passenger satellites are selected based on payload capacity available in the vehicle after loading the main satellite. The industry practice is to keep 70 kg as the maximum permissible pay load margin and fully utilise the balance pay load capacity to avoid idling of the satellite carrying capacity of the launch vehicle. VSSC indicated (September 2015) that the payload margin was between 60 kg and 100 kg with an average of 80 kg.

Antrix explained that the process of selection of co-passenger for a mission involved discussions with PSLV Project on the excess capacity and the envelope that is available for utilisation by international customers, discussions of Antrix with various international customers about the possible launch opportunity with the set of mission parameters and applicable interface requirements and finally identification of the co-passenger satellite.

We observed that there was no documented policy on the procedure for selection of co-passenger customers by Antrix along with rules of precedence and the manner of delivery of PSLV services to such customers duly approved by the competent authority. This was particularly significant, as there was huge demand for PSLV launch service in the smaller satellite category and co-passenger satellites contracted with Antrix had to wait for more than four months to 100 months to launch their satellites through PSLV. Further, underlining the importance to have a more open approach in the launch of co-passenger satellites, CMC-DOSIA also directed (June 2012) DOS/Antrix that co-passengers with PSLV C20 were to be made known to all the concerned agencies.

Our scrutiny also revealed that for the national/ commercial main missions, optimum pay load capacity was not utilised in five missions (C7, CA14, CA20, CA21 and CA23). The unutilised capacity ranged between 11 kg to 65 kg, which is substantial given that the current per kg cost of the CA version of PSLV was ₹ 18.70 lakh per kg³².

DOS stated (July 2016) that finalisation of co-passengers are governed by several parameters such as mass/dimensions, orbital requirements, launch schedule and not in order of precedence. DOS further stated that besides weight, availability of

³² SP of CA version of PSLV was ₹ 187.07 crore for 2015-16 and pay load capacity was 1,000 kg to LEO. Therefore, per kg cost would be ₹ 18.70 lakh per kg.

volume in the payload bay and structural interfaces of co-passengers are also important aspects in deciding fill factor of the launcher payload capacity.

We are of the view that DOS needs to follow an open and documented approach to selection of co-passengers in accordance with directions of CMC-DOSIA that may be made known to all the concerned agencies.

3.4 Non-adoption of best practices in PSLV launch service agreements

As mentioned in Chapter 1, DOS entered into procured launch service agreements with external launchers to launch its communication satellites. We observed that best practices such as mass variation clause, advance payment, etc. that DOS committed to in the procured launch service contracts entered into with external agency were not included in the PSLV launch service agreements for services offered by DOS. Non-incorporation of these important clauses resulted in loss due to absence of provision for positive mass variation, loss due to delayed remittance of negative mass variation and unfavourable terms of payment as discussed in the following paragraphs.

3.4.1 Loss due to absence of provision for positive mass variation

Variation in mass of the actual satellite from the weight of the satellite contracted has a bearing on the pay load weights and the pay load margin planned in the launch vehicle. The international practice in launch service is to charge the mass variation beyond the contracted weight at rates specified in the contract. Further, the practice was also to limit the mass variation up to two to three *per cent*, as mass variation beyond these limits would affect planning of the pay loads and margin.

Our scrutiny of the PSLV launch service contracts of ISRO however, revealed that DOS did not include a specific clause in the contracts to charge positive mass variation from the contracted weight in all six main mission contracts and 18 out of 19 co-passenger contracts. Further, out of 25 contracts, in 10 contracts actual weights were beyond the maximum permissible limit of three *per cent*.

Non-inclusion of the mass variation clause resulted in loss of ₹ 2.55 crore to DOS in 10 co-passenger contracts as shown in Table 3.1.

Table 3.1: Loss due to non-incorporation of positive mass variation clause

Satellite/PSLV/ Date of launch	Contract wt kg	Amount received ₹ lakh	Actual wt Kg	Permissible extra wt @ 3%	Loss ₹ lakh
(1)	(2)	(3)	(4)	(5)=0.03*(2) + (2)	6=[(4)-(2)]x3 /2
1. LAPAN TUB/C7/ 10-Jan-07	50	132.7	56	51.5	15.92
2. NLS 4/ CA9/ 28-Apr-08	25.5	109.56	27.5	26.265	8.59
3. NLS 5/ CA9/ 28-Apr-08	14	102	16	14.42	14.57
4. RUBIN 8/ CA9/ 28-Apr-08	7	44.03	8	7.21	6.29
5. CUBESAT/ CA14/ 23-Sep-09	6	56.80	8	6.18	18.93
6. X SAT/ C 16/ 20-Apr-11	100	549.25	105.5	103	30.21
7. VESSELSAT/ CA18/ 12-Oct-11	25	350.95	28.7	25.75	51.94
8. STRAND 1/ CA20/ 25-Feb-13	6	85.54	6.5	6.18	7.13
9. AISAT/ CA23/ 30-Jun-14	10	122.19	14	10.3	48.87
10. NLS 7/ CA23/ 30-Jun-14	25	262.24	30	25.75	52.45
				Total	254.90

DOS agreed (July 2016) to include a clause in the contract indicating the maximum permissible mass to be launched free of cost. DOS however, stated (November 2016) that for low mass satellites a mass variation percentage of 10 to 15 *per cent* was to be considered and not three *per cent*.

As DOS did not incorporate the clause for mass variation, we compared the mass variation allowed in the PSLV launch services with the prevailing international practice of three *per cent*. Further, of the 10 cases reported in Table 3.1, the mass variation exceeded 12 *per cent* in seven cases.

3.4.2 Non-levy of penal interest on late payments

The PSLV launch service agreements provided that penal interest of 10 *per cent* would be levied for delay in payment beyond the due date. As payment terms were linked with milestones for achievement of various stages of activity, the completion of these milestones was to be indicated so as to identify delayed payments, if any. We observed that Antrix did not record the dates of completion of milestones in five contracts. As a result, delays in receipt of payments, if any, could not be identified.

Lack of documentation of achievement of committed milestones that are linked to payments renders the penal interest clause redundant and may result in undue benefit to the clients.

DOS assured (July 2016) that the dates of different mile stone payments would henceforth be clearly indicated in the contract.

3.4.3 Unfavourable terms of payment

We observed that there were no uniform terms of payment for PSLV launch services in all six main mission and 19 co-passenger contracts reviewed. Terms of the contracts provided for milestone payments that varied from contract to contract.

While entering into contracts for launch of communication satellites through procured launches, DOS committed to 100 *per cent* advance payment to the launch service provider whereas in PSLV contracts, we observed cases of milestone payments to be made after placing the vehicle at the launch site and ready for launch.

The details of distribution of milestone payments in the six main mission and 19 co-passenger contracts reviewed are given in Annexure 3 and observations on non-receipt of 100 *per cent* advance payment are briefly discussed below:

- a. In main mission contracts, an average 37.49 *per cent* of payments were received after placing the vehicle at the launch site and ready for launch and 4.17 *per cent* of the payment was received during launch minus six months.
- b. Similarly, in co-passenger contracts on an average 27.28 *per cent* of payments were made after placing the vehicle at the launch site and almost 15 *per cent* of the payments were received around launch minus six months.
- c. In three main mission contracts (Agile, Tecsar and TELEOS) and six co-passenger contracts, last milestone payments were payable after the launch as per the contract. Of these six cases, in one case, the last milestone payment, payable after launch (February 2013), amounting to Euro 3,00,000 (₹ 2.08 crore) from Neosat contract (PSLV CA20) was not received as of July 2016.
- d. In five contracts (PEHUENSAT/C7, X SAT/ C 16, VESSELSAT/CA18, PROITERS/ CA21, AISAT/ CA23) the exact due dates on which the milestone payments were to be received was not indicated. Instead, dates of completion of stages of 'documentation/activities' were mentioned in the contract. However, the subsequent intimation of firm dates for the completion of these stages of 'documentation/activities' was not on record.

Thus, in its commercial contracts, DOS extended payment terms that were advantageous to the clients.

DOS stated (July 2016) that payment terms are fixed after negotiation with the customer. DOS added that milestone payment terms are minor incentives given to the contractor for not resorting to re-launch guarantee.

DOS needs to incorporate guidelines in its policy for delivery of launch services, for terms of payment keeping the above aspects in view and duly approved by the

competent authority, so as to avoid ad hoc terms of payment in PSLV launch contracts.

3.5 Conclusion

There was no approved mechanism for examination and vetting of proposals for delivery of PSLV launch services from administrative and financial angles. Antrix selected customers for co-passengers through consultative exercise with DOS, however, there was no documented and approved policy for selection of co-passenger customers along with rules of precedence and the manner of delivery of PSLV services to such customers. There was no uniform policy for realisation of payments for PSLV launch services. Terms of payment relating to distribution of milestone payments varied in different contracts, which were beneficial to the clients.

Management of payload capacity in launch vehicles was sub-optimum. Contractual provisions such as mass variation clause, advance payment, etc. that DOS committed to in the procured launch service contracts entered into with external agency were not included in the PSLV launch service agreements for services offered by DOS.

3.6 Recommendations

We recommend that:

1. DOS may ensure that proposals for PSLV launches are examined and approved by the Space Commission and Ministry of Finance.
2. DOS may establish a mechanism for submission, examination and vetting of proposals for PSLV customers and put in place a transparent policy for selection process for PSLV customers.
3. DOS may ensure that contractual provisions commonly followed internationally are also duly incorporated in the contracts entered for PSLV launch services.
4. DOS may document a policy for fixing of terms of payment in PSLV contracts.



4

CHAPTER



4

Launch of Geo-stationary satellites

Chapter

4.1 Background

DOS commenced its Geosynchronous Satellite Launch Vehicle (GSLV) programme in 1991 and realised its first successful developmental mission in the year 2001. This indigenous GSLV (GSLV MK II) is capable of launching 2,000 kg (1 to 2K) class of satellite. GSLV is used to launch Geo-stationary satellites meant for communication related applications into circular Geo-stationary orbit above equator at around 36,000 km altitude. There have been nine GSLV launches from 2001 to 2015. Out of the nine launches, five³³ were of developmental nature and remaining four³⁴ were used for operational purpose. Out of nine GSLV launches, there were six successful missions and remaining three³⁵ were unsuccessful. DOS was using procured cryogenic engine³⁶ in its indigenous GSLV missions initially; however, it developed indigenous cryogenic engine in January 2014 which was successfully used in GSLV D5 and GSLV D6.

From the year 2000 to 2015, 18 Geo-stationary satellites launched were operational. Out of this, six satellites were launched using indigenous GSLV launch vehicles (GSLV MK II) while 12 satellites were launched using procured launch services under five procured launch service contracts. The launch cost for these procured launch services under five contracts was ₹ 4,366.54 crore. The details of the successful GSLV and procured launches are given in the Table 4.1.

³³ Developmental Vehicle: GSLV D1, GSLV D2, GSLV D3, GSLV D5 and GSLV D6.

³⁴ Operational Vehicle: GSLV F01, GSLV F02, GSLV F04 and GSLV F06.

³⁵ Unsuccessful missions: GSLV F02, GSLV D3 and GSLV F06.

³⁶ Cryogenic engine is a rocket engine which uses cryogenic fuel. Cryogenic fuel are gases liquefied and stored at very low temperature.

Table 4.1: Details of successful GSLV and procured launches from 2000 to 2015

Satellite	Vehicle	Weight (kg)	Launch date	Remarks
GSLV launches				
1. GSAT 1	GSLV D1	1,530	18 Apr 2001	
2. GSAT 2	GSLV D2	1,825	08 May 2003	
3. GSAT 3/ EDUSAT	GSLV F01	1,950	20 Sep 2004	GSLV MK II type of vehicle
4. INSAT 4CR	GSLV F04	2,140	02 Sep 2007	
5. GSAT 14	GSLV D5	1,982	05 Jan 2014	
6. GSAT 6	GSLV D6	2,117	27 Aug 2015	
Procured launches				
1. INSAT 3B	Ariane 5	2,070	22 Mar 2000	Launched through single contract
2. INSAT 3C	Ariane 5	2,750	24 Jan 2002	
3. INSAT 3A	Ariane 5	2,950	10 Apr 2003	Launched through single contract
4. INSAT 3E	Ariane 5	2,775	28 Sep 2003	
5. INSAT 4A	Ariane 5	3,081	22 Dec 2005	Launched through single contract
6. INSAT 4B	Ariane 5	3,025	12 Mar 2007	
7. GSAT 8	Ariane 5	3,093	21 May 2011	Launched through single contract
8. GSAT 10	Ariane 5	3,400	29 Sep 2012	
9. GSAT 7	Ariane 5	2,650	30 Aug 2013	Launched through single contract
10. INSAT 3D	Ariane 5	2,060	26 Jul 2013	
11. GSAT 15	Ariane 5	3,164	11 Nov 2015	
12. GSAT 16	Ariane 5	3,182	07 Dec 2014	

Out of the above, two operational missions of GSLV MK II type (GSLV F01 and F04) and all 12 procured launch missions were reviewed in Audit.

This chapter brings out audit observations on planning for the launch of Geo-stationary satellites and procurement and contract management issues in the procured launch for Geo-stationary satellites.

Part A: Planning for the launch of Geo-stationary satellites

4.2. Synchronisation issues in GSLV MK II operational launch vehicle

Gol approved 10 GSLV MK II operational missions for ₹ 2,270 crore to be launched during 2005-11 to meet the communication satellite (1-2K) requirement of 11th Five Year Plan. Additionally, Gol further approved six vehicles for ₹ 1,280.96 crore in the year 2008 to meet the additional requirement of 11th Five Year Plan and beyond.

Out of these 16 vehicles, four vehicles used external cryogenic engine and remaining 12 launch vehicles were to use indigenous cryogenic engine. The Research and Development of indigenous cryogenic engine by ISRO was under process at the time of approval of GSLV MK II operational mission. Therefore, Gol had approved 12 operational vehicles in anticipation of the success of cryogenic engine.

Of these 16 GSLV MK II vehicles, six vehicles only were used by August 2015 and remaining 10 vehicles were planned to be spread over to various national missions up to the year 2021.

Three satellites GSAT 6 (₹ 235 crore), GSAT 9 (₹ 140 crore) and GSAT 6A (₹ 236.90 crore) were scheduled to be completed in October 2007, March 2010 and December 2011 respectively. While GSAT 6 was launched in August 2015 after a delay of approximately eight years, GSAT 9 is now planned to be launched in March 2017 and GSAT 6A in March 2020. The first development flight of GSLV MK II with indigenous cryogenic engine flew only in January 2014.

We observed that DOS got its operational communication satellites approved when GSLV MK II with indigenous cryogenic engine did not complete its developmental missions. The idling of the satellites due to delay in the operationalisation of GSLV is given in the Table 4.2.

Table 4.2: Idling of satellites due to non-availability of launch vehicle

Satellite	Scheduled date of launch	Actual date of launch	Rescheduled date of launch	Delay in launch/ Schedule of launch (in years)
1. GSAT 6	Jun 2008	27 Aug 2015	NA	7.2 (Approx.)
2. GSAT 9	Mar 2010	Rescheduled	Mar 2017	7
3. GSAT 6A	Dec 2011	Rescheduled	Mar 2018	6.3

Thus, due to non-synchronisation of communication satellite development programme with the GSLV launch vehicle development programme, three communication satellites developed at the cost of ₹ 611.90 crore were idling/delayed for period ranging from six to seven years. Moreover, DOS did not resort to procured route since it was of the view that launching 2,000 kg plus class of (1 to 2K) satellite through procured route was not financially viable. DOS desired to launch these smaller satellites meant for national use only through its indigenous GSLV MK II. Delayed launch of these satellites had impacted the intended national and strategic use of three satellites.

DOS replied (July 2016) that GSLV MK II vehicle together with 2,000 kg class of satellite is financially viable. DOS also added that synchronisation issues are inevitable during the progress of indigenous development in the Scientific Departments. GSAT 6 and GSAT 6A went through mid-course correction and GSAT 9 is being reconfigured.

The fact remained that due to non-synchronisation of launch vehicle development with satellite development programme, launch of three satellites were delayed for periods ranging from six to seven years.

Part B: Procurement and contract management issues in the procured launch for Geo-stationary satellites

4.3 Irregular award of work to contractor other than L1

As per Rule 160 of GFR, bids received should be evaluated in terms of the conditions already incorporated in the bidding documents. No new condition, which was not incorporated in the bidding documents, should be brought in for evaluation of the bids. Determination of a bid's responsiveness should be based on the contents of the bid itself without recourse to extrinsic evidence. Bidders should not be permitted to alter and modify their bids after expiry of the deadline for receipt of bids.

In response to the limited tender invited by ISRO for procured launch services for the satellites INSAT 4A and INSAT 4B, three parties submitted their bids. Out of the three parties two bids (Arianespace, France and International Launch Service, USA) were found technically suitable. Further, the bid of International Launch Service (ILS) was the lowest and technically suitable bids with quote of USD 82 million while Arianespace, France (ASF) had quoted USD 100 million. The difference in price is USD 18 million amounting to ₹ 82.38 crore³⁷. While comparing the bids, the committee constituted for the purpose for evaluating the bids, stated that ASF had offered free re-flight/ Launch Risk Guarantee (LRG) which ILS did not offer and which may cost additional USD 10-12 million for two flights.

We observed that the committee arrived at the cost of LRG as USD 10-12 million, on its own which was against Rule 160 of GFR and did not confirm the cost of LRG from ILS for comparing the bids, details of which are given in Table 4.3.

Table 4.3: Comparison of bids

Particulars	Arianespace (Price in million USD)	ILS (Price in million USD)
1. Best and Final Offer	100	82
2. Waiver of mass variation charges by Arianespace	8.8	-
3. LRG cost that would be saved as per the committee's remarks	10-12	-
Effective cost = (1) – (2+3)	81.2	82

General industry practice in procured launch service is that insurance premium in place of LRG is around five *per cent* of the launch cost. The LRG cost should have been around³⁸ USD four to five million for both the satellites as compared to USD 10-12 million worked out by ISRO. The committee neither took into account the market price for insurance nor LRG at prevailing cost.

³⁷ 1 USD= ₹ 45.765 (the least exchange rate on the date of payments of INSAT 4A/ 4B).

³⁸ The five *per cent* of USD 81.20 million works out to USD four to five million.

Thus, against the provisions of Rule 160 of GFR, DOS/ISRO inserted a new condition for the evaluation of bids for procured launch services for the satellites INSAT 4A and INSAT 4B which made ASF the lowest bidder.

DOS justified (December 2002) award of contract to ASF on various grounds such as (a) additional efforts in case of ILS such as analysis, testing etc. because of the new vehicle interface, the complex mission planning for the nine hours' flight to GSO, etc. and (b) full clarity did not exist regarding the export clearance of US Government etc.

The contention of DOS is not acceptable since award of contract to other than L1 was against the financial provisions. Further, ISRO did not consider other positive aspect of bids of ILS which were recommended by its sub-committee such as the advantage of extra orbit life of the satellites for launch directly to GSO and advantages in terms of launch scheduling and launch postponement because of the dedicated flight offer of ILS. Further, regarding export clearance of US Government, ILS had expressed confidence in obtaining the export clearance from US Government and was also willing to furnish Bank Guarantee for enabling 100 *per cent* refund in case of failure on their part to obtain export license.

Thus, ISRO did not follow the basic principles of public procurement enshrined in GFR and extended undue favour to ASF.

DOS replied (July 2016) that evaluation criteria mentioned in the RFP included LRG and USD 10 million of LRG was realistic based on the insurance market conditions. DOS also stated that it was currently obtaining quotation for LRG separately and LRG evaluation criteria was not a post evaluation development and was mentioned in the Cabinet note.

We are of the view that though RFP mentioned provision of LRG as one of the criteria, however, it was not mentioned that in the absence of free LRG, bid would be rejected or the cost of LRG would be presumed by DOS on their behalf as USD 10 to 12 million. Thus, DOS did not specifically mention the criteria objectively in the RFP.

4.4 Loss in INSAT 3D contract

Rule 137 and 160 of GFR provide that all Government purchases should be made in a transparent, competitive and fair manner, to secure best value for money.

The RFP for the procured launch of INSAT 3D was sent (prior to August 2010) to four parties viz. (1) International Launch Services (ILS), (2) Ariane Space, France (ASF), (3) Boeing and (4) Sea launch. Boeing and Sea launch did not respond to the quote. The Contract Finalisation Committee (CFC) decided that re-floating the tender would not yield any new competent vendor and it was decided to open the quotes of ILS and ASF. The quote of ILS was USD 100 million against which the quote of ASF was USD

65 million. The price negotiation was held in September 2010 and ASF agreed to bring down the cost of INSAT 3D launch for USD 63.8 million for 2,100 kg class of satellite including USD 3.8 million towards LRG.

However, due to some difference of opinion within DOS regarding modification of certain commercial terms in the offer of ASF, the contract was not entered and DOS did not go ahead with this PLSA. Subsequently a fresh RFP was invited (June 2011) from the five launch service providers. Only one party i.e. ASF submitted the bid by July 2011. Against the initially finalised rate of USD 63.8 million, the price finalised for INSAT 3D was USD 82.2 million. The difference in the price and loss to DOS for the launch of INSAT 3D would work out to USD 18.4 million which would be ₹ 97.06 crore at the rate of ₹ 52.75 per USD when PLSA was finally signed 17 October 2012.

We observed that no justification for postponing/ cancellation of the procurement process was available on record. We also observed that while processing the single bid received from ASF after the second round of tendering, there was no reference in the files to the aborted attempt to finalise contract in the first round of bidding. Thus, cancellation of the procurement without any valid reasons resulted in the escalation of cost of the launch service. The loss incurred by ISRO due to the cancellation of the procurement process was USD 18.4 million amounting to ₹ 97.06 crore.

DOS (July 2016) stated that besides quoting for regular Ariane-5 launch vehicle at the standard rate, ASF proposed a new option of providing the Russian Soyuz launcher as launch vehicle, the price of which was the lowest (L-1). DOS further stated that ASF did not offer LRG as a part of the offered price. DOS also added that due to non-inclusion of LRG by ASF in the offered price and considering the risk involved in availing the launch by a new launcher from a new facility, the CFC did not converge on a decision on the L-1 and it was decided to retender and therefore cancellation of the contract was a considered decision and cannot be termed as a loss to ISRO. DOS further stated that there were risks involved in opting for the Soyuz vehicle which led to retendering.

The reply is not acceptable as there was no difference of opinion on the issue of utilisation of Soyuz launcher in the CFC meeting of August 2010. The difference of opinion was only on commercial terms of the contract. Thus, not entering into the contract within the validity period resulted in avoidable extra expenditure of ₹ 97.06 crore.

4.5 Loss on competitive bid due to obligation of postponement fee of INSAT 3A

Rule 160 of GFRs states that bids should be evaluated only based on the criteria stipulated in the bidding documents.

ISRO entered (November 2000) into contract with ASF for launch of INSAT 3A. In terms of the contract, the launch period for INSAT 3A was from 01 December 2001 to 31 March 2002. INSAT 3A was actually launched in April 2003 since ISRO could not deliver the satellite on time for launch. ASF claimed (October 2002) postponement fee of USD 4.44 million while submitting the bid for INSAT 4A/4B and also offered to waive the same if the contract was awarded to them. ILS was the lowest technically suitable bidder for INSAT 4A/4B however the CFC took into account the offer of ASF to waive its obligations under INSAT 3A which was in violation of GFRs. We observed that inability of DOS to deliver the satellites on time led to the obligation to pay postponement fee of USD 4.44 million amounting to ₹ 20.64 crore³⁹. ASF relinquished its claim of postponement fee in lieu of the award (March 2003) of contract for launching service for INSAT 4A/4B to ASF. Thus, due to non-readiness of satellite, ISRO lost a competitive bid.

DOS replied (July 2016) that the delay in realization of INSAT 3A was due to delay in import of few of the components in view of the export control regime for the US. Thus, the delay was beyond the control of DOS.

We are of the view that bids must be evaluated based on criteria stipulated in the bidding documents as enshrined in GFR.

4.6 Loss due to non-incorporation of Liquidated Damages clauses in Procured Launch Service Contracts

In terms of the Para 5 and 6 of DOS Purchase manual (updated 2015), terms and conditions and formulation of Purchase order/ Contracts with provision for advance payments shall invariably incorporate Liquidated Damages (LD) clause at the rate of 0.5 *per cent* for the undelivered portion of the order value per week subject to a maximum of 10 *per cent*. Other contracts shall have LD clause at the rate of 0.5 *per cent* of the order value per week or 0.5 *per cent* of the value of the stores for which the delivery is delayed for each week of delay, as the case may be, subject to a maximum of 10 *per cent* of the order value with the concurrence of the concerned Purchase Committees.

³⁹ 1 USD= ₹ 46.485 (the least exchange rate on the date of payments of INSAT 3A).

We, however, observed that in none of the procured launch contracts, LD clause was incorporated by ISRO. We observed in two cases delay was on the part of ASF. The LD in these cases worked out to ₹ 85.33 crore as detailed in the Table 4.4.

Table 4.4: Liquidated Damages

Satellite	Contract value in million USD	Value in ₹ crore	Last day of Launch schedule	Launch date	Delay in launch in days	Delay in launch in weeks	LD to be levied @ 0.5 per cent per week	Effective LD maximum @ 10 per cent	LD in ₹ crore
INSAT 3C	78.40	340.60	31.03.01	24.01.02	299	42	21.5	10	34.06
Reason for the delay									
As per the contract, the satellite was to be launched by March 2001. Later ASF informed that the satellite would be launched in January 2002 since the other satellite which was planned by ASF to launch along with INSAT 3C was not ready. In spite of the reservation of DOS for launching the satellite with so much delay, INSAT 3C was launched in January 2002.									
GSAT 15	87.36	539.68	30.06.15	11.11.15	134	19	9.5	9.5	51.27
Reason for the delay									
Launch of GSAT 15 was delayed to match the launch slot with ASF.									
Total									85.33

Therefore, due to non-incorporation of LD clause in the contracts the same could not be levied, resulting in loss of ₹ 85.33 crore.

DOS replied (July 2016) that LD clause is incorporated in the current procured launch contracts whereas earlier contracts had delivery period uncertainties due to high degree of R&D activities. DOS however stated (November 2016) that the delays were primarily due to DOS/ISRO and not ASF. The reply is not acceptable, as the delay was on the part of ASF as indicated in Table 4.4 above. Further, DOS did not elaborate on the reasons for delay by DOS, as stated by them.

4.7 Loss of interest due to non-incorporation of time schedule for the refund of mass variation credit

Rule 204 (i) of GFR, 2005 stipulated that the terms of the contracts must be precise, definite, and without any ambiguities. The clarity of the terms of contract would not give scope for subsequent misconstruction during the execution stage of the contract.

The variation in mass of the satellite from contracted mass to actual lift off mass is compensated in the contract. The positive variation in mass was to be paid by DOS and negative mass variation was to be compensated by the contractor. Our scrutiny revealed that out of five procured launch service contracts in operation from the year 2000 to 2015, the negative mass variation credit claim existed in two contracts viz., INSAT 4A/ 4B and GSAT 8 contracts. As per the contract, the actual mass was required to be intimated to the contractor by launch minus four months.

We observed that no time period for making the refund in case of negative mass variation of the satellite was incorporated in the contract. We observed that ASF delayed in making the refund by periods ranging between five to 23 months in two contracts (three satellites) due to which ISRO incurred loss of interest of ₹ 1.04 crore calculated at the rate of eight *per cent* from launch minus three months, as detailed in the Table 4.5.

Table 4.5: Loss of interest due to delayed refund (₹ in lakh)

Satellite	Contracted weight	Mass variation restricted (in kg)	Rate/kg (USD)	Refund claim (USD)	Refund (in ₹)	Date of Refund	Date of launch	Date from L-3	Delay (number of days) from L-3	Loss ⁴⁰ of interest ₹ lakh
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)= (6) x 0.08 x (11)/365
INSAT 4A	3,200	70	15,000	10,50,000	4,27,12,425	22-08-07 ⁴¹	22-12-05	23-09-05	698	65.34
INSAT 4B	3,200	70	15,000	10,50,000	4,27,12,425	22-08-07	12-03-07	13-12-06	252	23.59
GSAT 8	3,200	70	15,000	10,50,000	4,65,66,613	21-07-11	21-05-11	22-02-11	149	15.21
Total loss of interest										104.14

DOS agreed in the exit meeting (July 2016) to incorporate specific clause in the future procured launch contracts.

4.8 Conclusion

There were deficiencies in planning of the launch of GSLVs. DOS got its operational communication approved from GoI when GSLV MK II with indigenous cryogenic engine did not complete its developmental missions. Due to non-synchronisation of planning of communication satellite development programme with GSLV launch vehicle development programme, three communication satellites were idling/delayed for a long period of six to more than seven years.

There were instances of poor contract management such as award of contract to launcher other than L1, cancellation of contracts without giving valid reasons, uncertain terms for refund of negative mass variation credit, etc.

4.9 Recommendations

We recommend that:

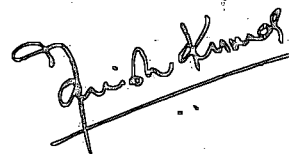
1. DOS may plan launch of operational communication satellites with indigenous GSLV only if the launch vehicle has reached operational phase to ensure that planned satellites are launched in time.

⁴⁰ Interest at the rate eight *per cent per annum*.

⁴¹ Refund for both INSAT 4A and INSAT 4B was deducted from the payment of GSAT 8.

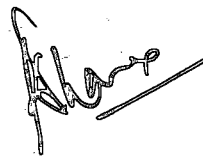
2. DOS may evolve a mechanism to synchronise its satellite development programme with the schedule committed in the agreements for launch of communication satellites so as to secure best price for the procured launches.
3. DOS may adhere to rules/guidelines in GFR/ CVC Guidelines/DOS purchase procedure to streamline the due processes in the award of launch service contracts.

New Delhi
Dated: 22 November 2016



(MANISH KUMAR)
Principal Director of Audit
Scientific Departments

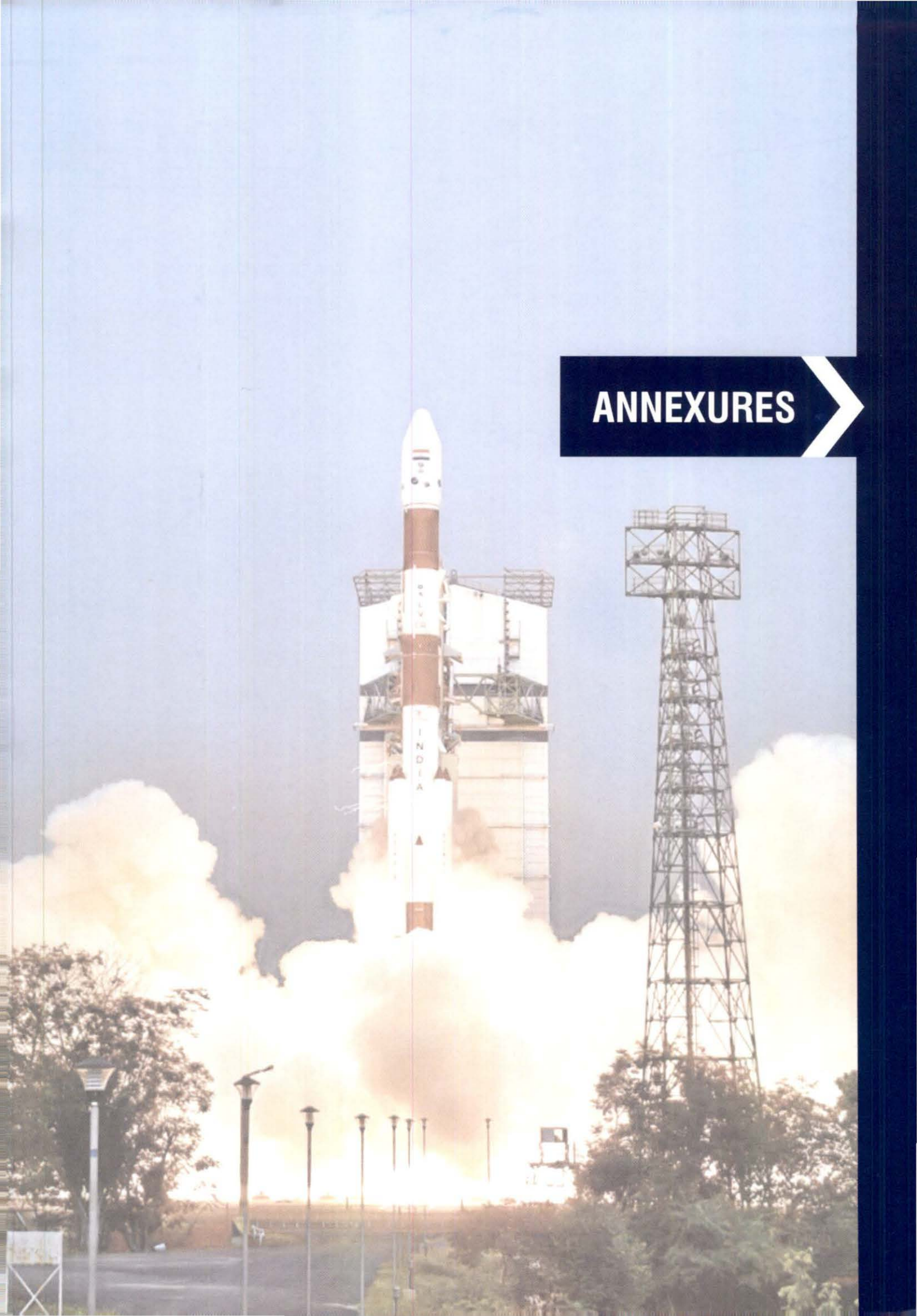
Countersigned



New Delhi
Dated: 25 November 2016

(SHASHI KANT SHARMA)
Comptroller and Auditor General of India

ANNEXURES





Annexure: 1 (Refer Para 2.2)

Year wise PSLV Planning from Five Year Plan, Financial Sanction, to Actual Launch (1997 to 2016)

Year	IX th /X th /XI th /XII th Five Year Plan	Financial sanctions/C7 to C13 of 2002/ C14 to C28 of 2008 C36 to C50 of 2015	Actual Launch
1997-2002	1) IRS-1D/C1 2) IRS-P4/C2 3) TES/C3	1) IRS-1D/C1 2) IRS-P4/C2 3) TES/C3	1) IRS-1D/C1 2) IRS-P4/C2 (KITSAT-3/DLR TUBSAT) 3) TES/C3 (BIRD/PROBA)
2002-03	1) Metset -1/C4	1) Metset-1(C4)	1) Metsat-1 (C 4)
2003-04	1) Resourcesat-1/ C5 2) Cartosat-1 (C6)	1) Resourcesat-1 (C5) 2) Cartosat-1 (C6)	1) Resourcesat-1 (C5)
2004-05	SRE-1/Cartosat-2/C7	1) SRE-1/Cartosat-2/(C7) 2) Cartosat 2A 3) Cartosat 2B	
2005-06	1) Metset-2 (C 8) 2) RISAT-1 (C9) 3) Astrosat (C10)	1) Metsat-2 (C 8) 2) RISAT-1 (C9) 3) Astrosat (C10)	1) Cartosat-1 /C6 (HAMSAT)
2006-07	1) Meghatropique (C11) 2) Oceansat-2 (C12)	1) Megha-Tropiques (C11) 2) Oceansat-2 (C12)	1) Cartosat-2/C7 (SRE/ LapanTubsat/ PEHUENSAT 1)
2007-08	1) TWSAT/C8 2) Oceansat-2/C8 3) Chandrayan-1/C9 4) Astrosat-1/C10	1) Resourcesat-2 (C13) 2) RISAT-2 3) Chandrayan-1	1) Agile/C8 2) Polaris (Tecsar)/C10
2008-09	1) Resource -2/C11 2) RISAT -2/C12 3) Meghatropiques/C13 4) IRNSS-1/C14 5) IRNSS-2/C15 6) SRE-2/C11		1) Cartosat 2A/C9 (CAN X2/ CUTE 1.7/DELFI C3/ AAUSAT II/ COMPASS I/ SEEDS/ NLS 5/ RUBIN 8/IMS 1) 2) Chandrayaan-1/C11
2009-10	1) GEO-HR/ C16 2) Altika-Agros/ C17 3) IRNSS-3/ C18 4) IRNSS-4/ C19	1) IRNSS 1 (C14) 2) Resourcesat-2 (C15) 3) Megha-Tropiques (C16) 4) Astrosat (C17)	1) RISAT 2/ C12 (ANUSAT) 2) Oceansat-2/C14 (CUBESAT 1-4/ RUBIN 9.1-9.2)
2010-11	1) TES-HYS/C20 2) IRNSS-5/ C21 3) IRNSS-6/ C22 4) I-STAG/C20	1) IRNSS 2 (C18) 2) IRNSS 3 (C19) 3) IRNSS 4 (C20) 4) IRNSS 5 (C21)	1) Cartosat 2B/ C15 [ALSAT 2A /NLS 6.2 (TISAT 1) / NLS 6.1 (AISSAT 1)/STUDSAT]
2011-12	1) Resource-3/ C23 2) DMSAR-1/ C23 3) Cartosat-3/C24 4) IRNSS-7/C25 5) Aditya/C26	1) TES HYS/Hyperspectral (C22) 2) Altika Argos/ SARAL (C23) 3) IRNSS 6 (C24) 4) IRNSS-7 (C25)	1) Resourcesat-2 (C16) (X SAT/ YOUTHSAT) 2) GSAT-12/ (C17) 3)MEGATROPIQUES/ C18 (SRMSAT/ JUGNU / VESSELSAT)
2012-13	1) Saral/ C20 2) IRNSS-1/ C21 3) Antrix / C22	1) Resourcesat-3 (C26) 2) Aditya (C27) 3) Cartosat-3 (C28)	1) RISAT-1/ C19 2) SPOT-6/C21 (PROITERS/Mini Resins) 3) SARAL/ C20 (SAPHIRE/ NEOSSAT/ NLS.8.1-8.3/ STRAND)

C 7 to C 13 sanction plus 4 satellite

C14 to C28 sanction

2013-14	1) IRNSS-2/ C23 2) IRNSS-3/ C24 3) Astrosat/ C25 4) MARS/ C26	+1	1. MOM	1) IRNSS-1A (C22) 2) MOM (C25)
2014-15	1) Carto-2C/C27 2) IRNSS-4 /C28 3) IRNSS-5/ C29 4) IRNSS-6/ C30			1) IRNSS-1B (C24) 2) SPOT-7/C23 (AISAT/ NLS 7.1-7.2/ VELOX-1/AINS) 3) IRNSS-1C (C26) 4) IRNSS-1D (C27)
2015-16	1) Resorce-2A/C31 2) Carto-2D/C32 3) IRNSS -7/C33	+1	1. Cartosat 2C (Satellite-PPLS identified for commercial launch)	1) DMC- 1 to 3 (C28) (CBNT-1/Deorbitail) 2) TeLEOS-1 (C29) (Velox C1/ Velox C2/Athenoxat-1/ Kent ridge/Galassia) 3) Astrosat (C30) (Lapan A2/NLS 14/Lemur 1to4) 4) IRNSS 1E (C31) 5) IRNSS 1F (C32)
2016-17	1) Ocean-3/ C34 2) Carto-3/ C35 3) Aditya/ C36		1) Cartosat-2D (Microsat)	
2017-18			1. IRNSS 1H/C37 2. RISAT 1A/C38 3. Cartosat 2E/C39 (Satellite identified for commercial launch) 4. IRNSS 1I /C40 5. Hyperspectral (satellite-EMISAT identified for commercial launch) 6. Cartosat 3A	
2018-19			1. Resourcesat 3 /C41 (Satellite identified for commercial launch) 2. IRNSS 1J/C42 3. Commercial launch/C43 4. RISAT 3/C44 5. IRNSS 1K /C45 6. RISAT 2A 7. Cartosat 3B	
2019-20			1. Commercial launch/C46 2. Cartosat /C47 3. Oceansat 3/C48 (Satellite identified for commercial launch) 4. Commercial launch/C49 5. MSMR/C50 (Satellite not identified for commercial launch)	

C36 to C50 sanction plus 3 satellite

DOS reported in its cabinet note seeking approvals for PSLV C36 to C50 that Projects such as Cartosat 2A, Cartosat 2B, Chandrayan-1, RISAT-2, MARS (approved separately by Cabinet) together with commercial mission SPOT-6 mission extend the mission up to PSLV C-34. Further, DOS added that in terms of numbering, PSLV C13 is not used, hence the current approvals extend up to PSLV C35. In previous sanction (PSLV C14 to C28), Aditya mission was indicated PSLV C27. Since the satellite was not launched the same was indicated against PSLV C36.

Annexure: 2 (Refer Para 2.2)

Missions of PSLV (Status as of March 2016)

No.	Year	Missions	Description
1	1993	1	PSLV D1 : Developmental: IRS-1E satellite could not be placed in Orbit
2	1994	1	PSLV D2 : Developmental Mission: IRS P2 Satellite
3	1996	1	PSLV D3 : Developmental Mission: IRS-P3 Satellite
4	1997	1	PSLV C1 - Govt/ISRO/NRSC-RS : IRS-1D
5	1999	1	PSLV C2 - Govt/ISRO/NRSC-RS : Oceansat
6	2001	1	PSLV C3 - Govt/ National : TES
7	2002	1	PSLV C4 - Govt/ National-IMD : Kalpana
8	2003	1	PSLV C5 - Govt/ISRO/NRSC-RS : Resourcesat-1
9	2005	1	PSLV C6 - Govt/ISRO/NRSC-RS : Cartosat-1
10	2007	2	(i) PSLV C7 - Govt/ISRO/NRSC-RS: Cartosat-2/SRE-1 (ii) PSLV C8 - Private/Commercial: Agile
11	2008	3	(i) C9 - Govt/ National : Cartosat 2A (ii) C10 - Private/Commercial: TECSAR (iii) PSLV C11 - Govt/Science Mission : Chandrayan-1
12	2009	2	(i) PSLV C12 - Govt/ National : RISAT-2 (ii) C14 - Govt/ISRO/NRSC-RS : Oceansat-2
13	2010	1	C15 - Govt/ National : Cartosat 2B
14	2011	3	(i) C16 - Govt/ISRO/NRSC-RS : Resourcesat-2 (ii) C17 - Govt/ISRO: GSAT 12 (iii) PSLV C18 - Govt/ Indo French: Meghatropique
15	2012	2	(i) C19 - Govt/ISRO/ NRSC-RS : RISAT-1 (ii) PSLV C21 - Private/Commercial : SPOT 6
16	2013	3	(i) C20 - Govt/ Indo French : SARAL (ii) C22 - Govt/ Navigation : IRNSS-1A (iii) PSLV C25 - Govt/ Science Mission : Mars
17	2014	3	(i) C23 - Private/ Commercial : SPOT 7 (ii) C24 - Govt/Navigation : IRNSS-1B (iii) PSLV C26 - Govt/Navigation : IRNSS-1C
18	2015	4	(i) PSLV C27 - Govt/ Navigation: IRNSS-1D (ii) PSLV C28 - Private/Commercial: DMC-3 (iii) PSLV C29 - Private/Commercial: TeLEOS-1 (iv) PSLV C30 - Govt/ National :Astrosat
19	2016	2	(i) PSLV C31 - Govt/ Navigation: IRNSS-1E (ii) PSLV C32 - Govt/ Navigation: IRNSS-1F
Total		34	31 Operational Missions: Government Missions (25) [Govt/ISRO/NRSC-Remote Sensing (8), Govt/ National (6), Govt/Navigation (6), Govt/ Indo French (2), Govt/ Science (2) Govt/ISRO (1)] and Private/Commercial (6) 3 Developmental Missions

^ISRO - The revenue from the delivery of space products and services from ISRO satellite are collected by ISRO/ Antrix and the same is to be credited to Government Account; National – Satellites used towards national purpose; Commercial-Dedicated satellites meant for commercial use; Navigational – Satellite meant for navigational purpose; Science Missions – Meant for Scientific Community.

Annexure: 3
(Refer Para 3.4.3)

Table 1: Terms of Payment in Main Mission

Contractor/ Main mission	Date of Contract	Date of Launch	% of milestone payments as per contract					
			L* plus 1M**	Launch site(L-2M)	L Minus 2 to 6 M	L minus 6 to 12 M	L minus 12 to 18 M	L minus 18 M above
Cosmos Intl Germany/ Agile/ CA8	13-Jan-04	23-Apr-07	10%	25%	25%	-	-	40%
ISRAEL/ Teccsar/ CA 10	14-Aug-05	21-Jan-08	15%	30%	-	-	-	55%
EADS, Austrium, France/ SPOT 6/ CA 21	25-Jan-12	9-Sep-12	-	35%	-	65%	-	-
EADS, Austrium, France/ SPOT 7/ CA 23	17-Jun-13	30-Jun-14	-	35%	-	65%	-	-
SSTL, UK/ DMC 3/ C 28	29-Jan-14	10-Jul-15	-	40%	-	30%	30%	-
ST, Singapore/TELEOS /C29	5-Feb-14	16-Dec-15	10%	25%	-	20%	25%	20%

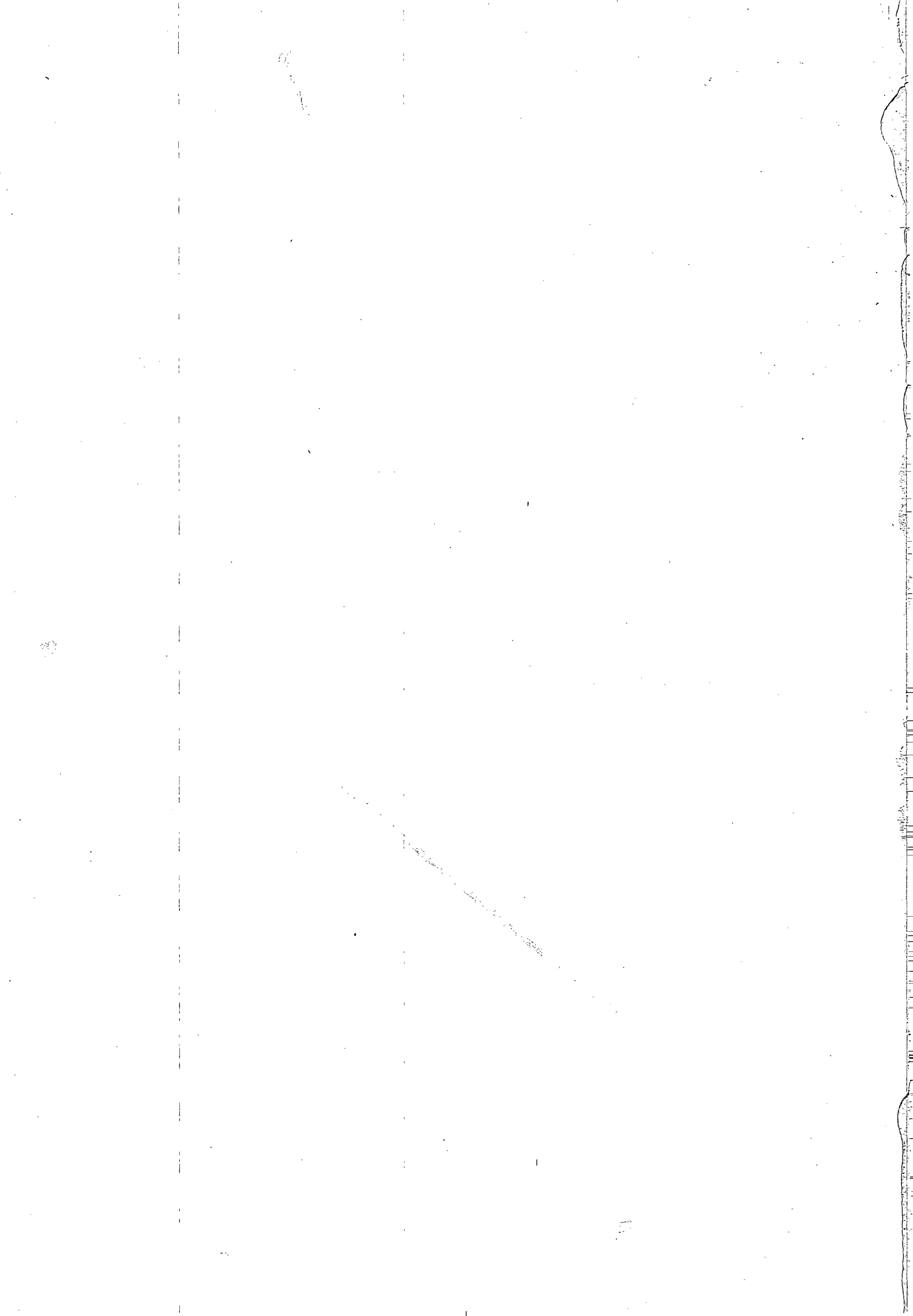
*L-Launch; **M-Month

Table 2: Terms of Payment in Co-passenger mission

Contractor/ Main mission	Date of Contract	Date of Launch	% of milestone payments as per contract					
			L plus 1M	Launch site (L-2M)	L Minus 2 to 6 M	L minus 6 to 12 M	L minus 12 to 18 M	L minus 18 M above
LAPAN TUBSAT/C7	2-Sep-04	10-Jan-07	-	-	-	-	-	100%
PEHUENSAT/C7	18-Feb-06	10-Jan-07	-	-	50%	50%	-	-
NLS 4/ CA9	11-Aug-06	28-Apr-08	10%	40%	-	-	-	50%
NLS 5/ CA9	11-Aug-06	28-Apr-08	10%	40%	-	-	-	50%
RUBIN 8/ CA9	26-Sep-07	28-Apr-08	-	50%	-	50%	-	-
CUBESAT/CA14	16-Oct-08	23-Sep-09	-	-	-	61%	39%	-
RUBIN 9.1-9.2/ CA14	21-Oct-08	23-Sep-09	-	50%	-	50%	-	-
ALSAT 2A/CA15	26-Aug-08	12-Jul-10	10%	30%	-	50%	-	10%
NLS 6/ CA 15	9-Dec-08	12-Jul-10	10%	40%	-	-	-	50%
X SAT/ C 16	24-Jan-03	20-Apr-11	-	23.4%	53.2%	-	-	23.4%
VESSSELAT/ CA18	13-Jan-11	12-Oct-11	-	40%	30%	30%	-	-
PROITERS/ CA21	1-Mar-09	9-Sep-12	-	20%	30%	-	-	50%
SAPHIRE/ CA20	5-May-09	25-Feb-13	10%	20%	20%	20%	-	30%
NEOSSAT/CA20	10-Mar-10	25-Feb-13	15%	-	-	-	-	85%
NLS 8/ CA20	30-Jul-10	25-Feb-13	-	50%	-	-	-	50%
STRAND 1/ CA20	15-Oct-12	25-Feb-13	-	-	100%	-	-	-
AISAT/ CA23	11-Aug-09	30-Jun-14	-	50%	-	-	-	50%
NLS 7/ CA23	25-Jun-09	30-Jun-14	-	-	-	-	-	100%
VELOX-1/ CA23	13-Oct-13	30-Jun-14	-	-	-	100%	-	-

Glossary of Terms

Abbreviation	Full Form
AAM	Advanced Avionics Module
Antrix	Antrix Corporation Limited
CFC	Contract Finalisation Committee
CMC-DOSIA	Coordination Management Committee of DOS and Antrix
CMD	Chairman cum Managing Director
COP	Cost of Production
CVC	Central Vigilance Commission
DOS	Department of Space
GFR	General Financial Rules
GSLV	Geo Synchronous Launch Vehicle
GSO	Geosynchronous Orbit
GTO	Geostationary Transfer Orbit
ICC	INSAT Coordination Committee
IISU	ISRO Inertial Systems Unit
INSAT	Indian National Satellite System
IPRC	ISRO Propulsion Complex, Mahendragiri
ISAC	ISRO Satellite Centre
ISRO	Indian Space Research Organisation
ISTRAC	ISRO Tracking and Telemetry network Centre, Bengaluru
LD	Liquidated Damages
LEO	Lower Earth Orbit
LPSC	Liquid Propulsion System Centre
LRG	Launch Risk Guarantee
LTA	Long Term Agreement
LVPO	Launch Vehicle Programme Office
MOF	Ministry of Finance
MOU	Memorandum of Understanding
NRSC	National Remote Sensing Centre
PAC	Public Accounts Committee
PLSA	Procured Launch Service Agreement
PSLV	Polar Satellite Launch Vehicle
PMO	Prime Minister's Office
RFP	Request for proposal
SAC	Space Applications Centre, Ahmedabad
SCNPO	Satellite Communication and Navigational Programme Office
SDSC-SHAR	Satish Dhawan Space Centre, Sriharikota
TTC	Telemetry Tracking and Command
VSSC	Vikram Sarabhai Space Centre, Thiruvananthapuram



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